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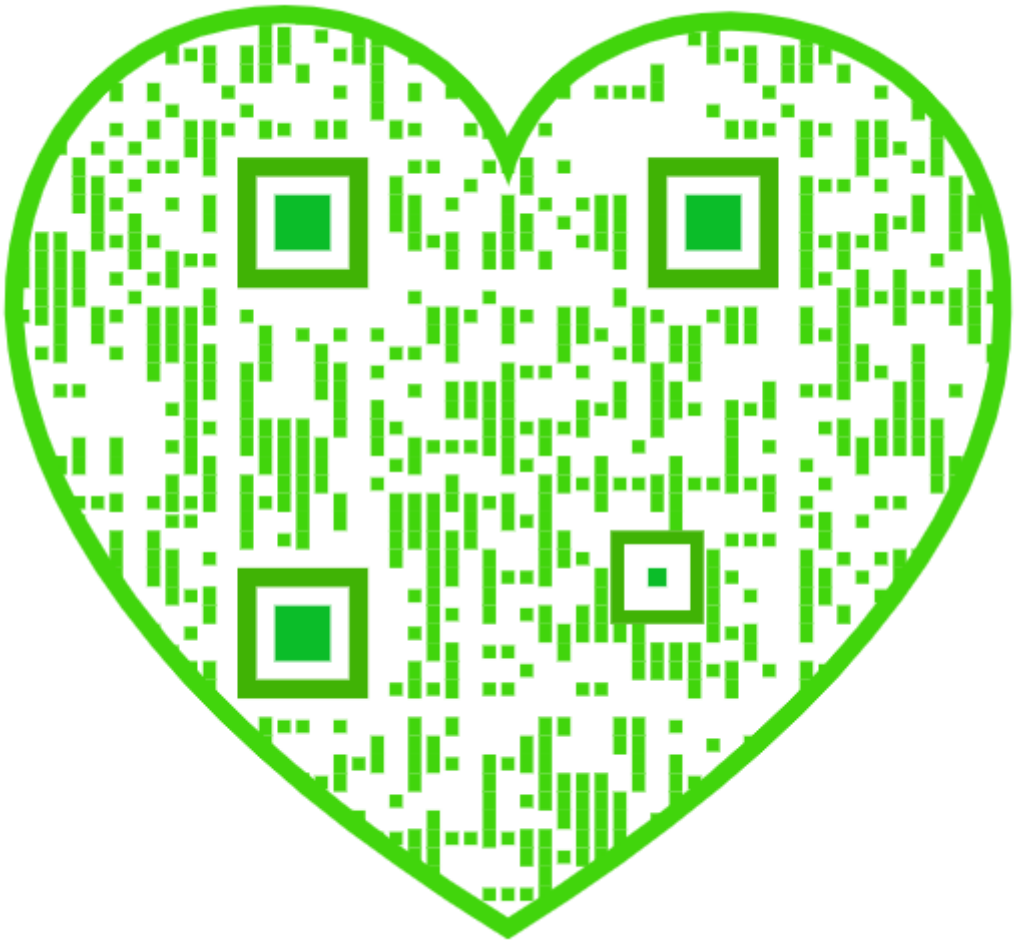

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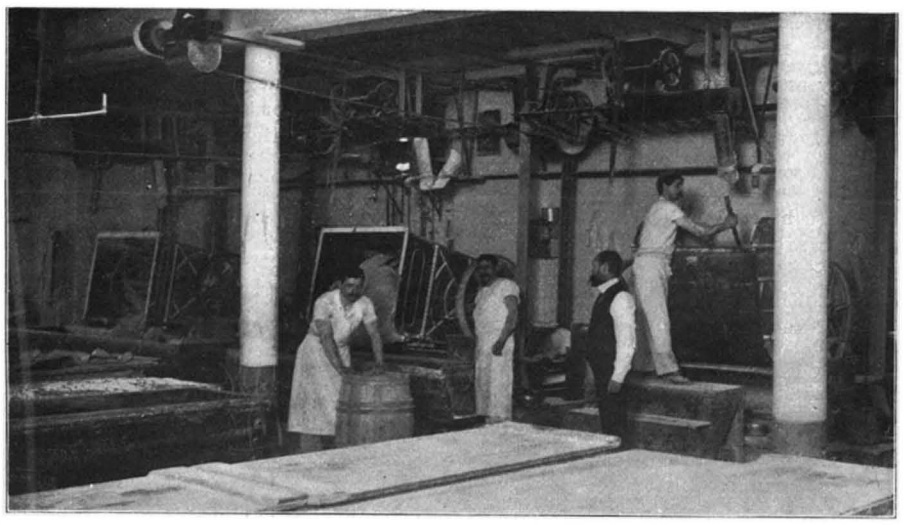
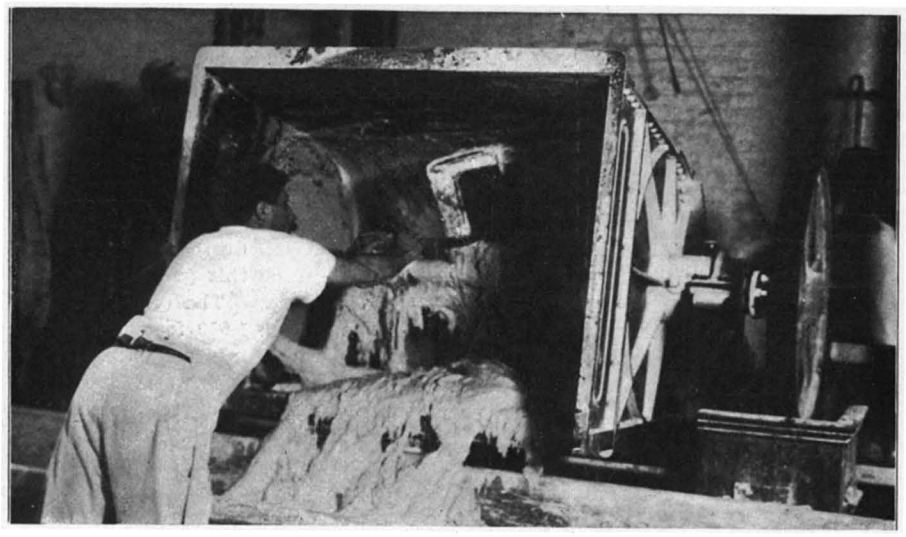
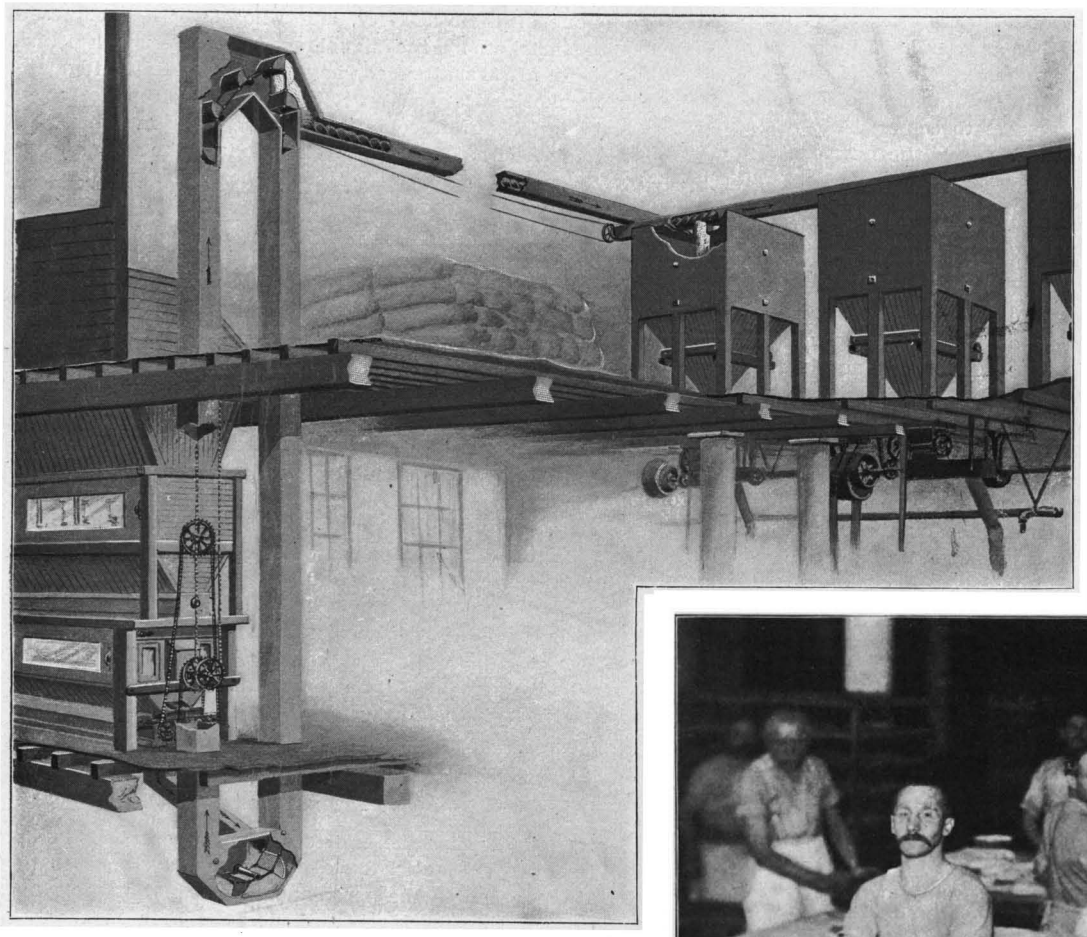


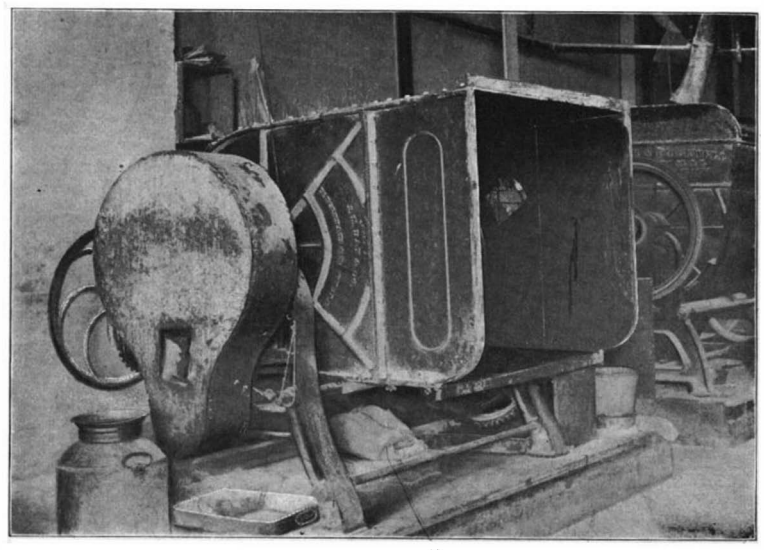
The Mixing-Machine and "Raising" Room.



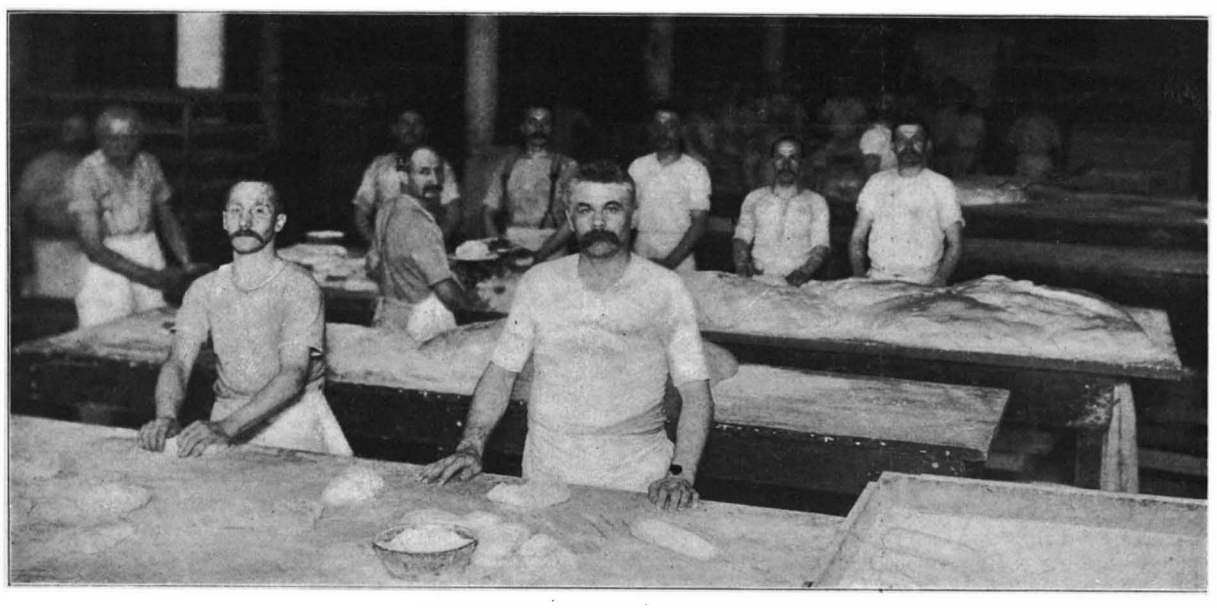
Cutting the Kneaded Dough from the Dashers.



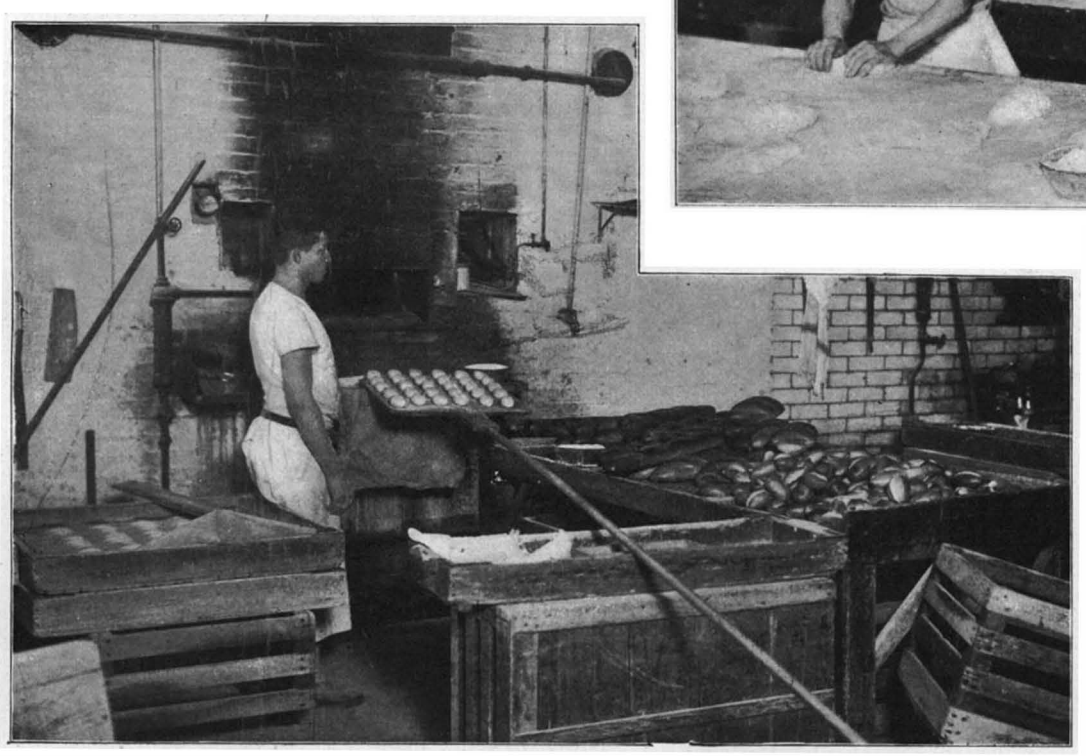
Flour Cleaning and Mixing Apparatus.



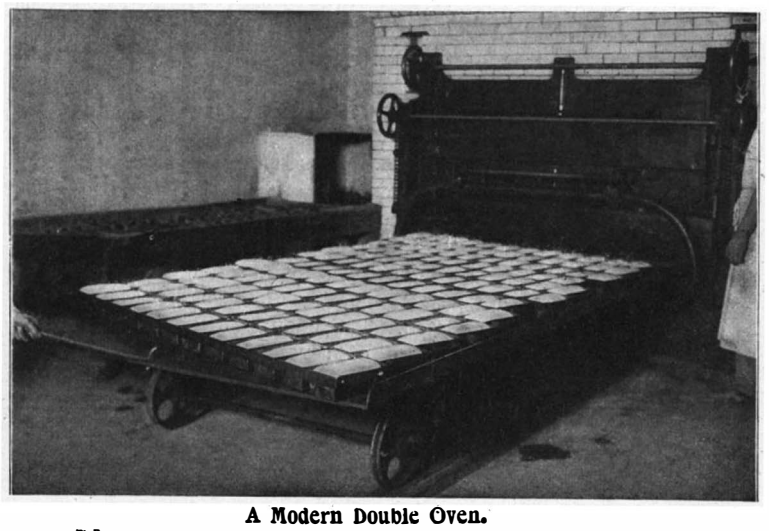
A Mixing Machine Tilted.



Moulding the Dough into Loaves.



At the Mouth of an Oven.



A Modern Double Oven.

MAKING BREAD BY MACHINERY.—[See page 7.]

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NEW YORK, SATURDAY, JANUARY 4, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RETROSPECT OF THE YEAR 1901.

Compared with the brilliant array of scientific achievements which marked the last decade of the nineteenth century, it must be admitted that the opening year of the twentieth century has been strangely barren; so barren indeed that one might almost believe that the inventive mind was resting from its strenuous labors and superb achievements of the previous decade. In the closing days of the year, however, the world has been again startled by one of those epoch-making events which suddenly burst upon the world with not even a hint of their approach. We refer, of course, to the feat of the young Anglo-Italian Marconi in communicating by his wireless system of telegraphy across 2,000 miles of the Atlantic Ocean. So extraordinary is the achievement that, had it been claimed by any other man than Marconi, doubts might well have been expressed; but the invariable modesty and unusual conservatism of the inventor have satisfied the world at large that no such announcement would have been made by Marconi had he not possessed the most undoubted proofs of his success. It is true that the range of wireless telegraphy had been steadily increasing, but there was no such rate of increase as to prepare our minds for a jump from 200 or 300 miles to 2,000 or 3,000. With such an achievement on record, it is likely that the future historian will speak of the year 1901 as a brilliant opening of a brilliant century.

EXPOSITIONS.

The year has seen the successful carrying through of two excellent expositions, one at Glasgow and the other our own Pan-American at Buffalo. The former, as was natural in such a great center of mechanical industries as Glasgow, was distinguished by the excellent quality of the exhibits in the departments devoted to machinery and transportation. Although it was not comparable in point of size to some recent expositions, the quality of the exhibits seems to have been eminently first-class, and, judged from a standpoint of finance, it appears to have been a very thorough success. The more elaborate and important Pan-American Exposition at Buffalo closed on November 2, after having achieved its object of promoting the commercial interests of this country by advancing the friendly relations and commercial intercourse between the United States and other countries of the two Americas. The total admissions for the first six months were close to eight millions; but owing to the destructive snowstorm of last April and the ever-to-be-lamented death of President McKinley, there will be a financial loss of about $3,000,000. The government's exhibit, which was remarkably fine, has been shipped to the Exposition at Charleston.

CIVIL ENGINEERING.

Although the last year has not seen the completion of any notable civil engineering works, steady progress has been made upon many great undertakings that had been commenced in earlier years.

The Croton Dam and Jerome Park Reservoirs have been pushed forward; but the date of completion of these important works has been postponed by a proposed reconstruction, which will probably have to be carried out to render them perfectly stable. The 600 feet of core-wall-and-earth dam at the southern end of the Croton Dam will, in all probability, be replaced by a solid masonry structure, constructed on the same section as the masonry portion of the structure that is already completed. The change will involve an increased expenditure of several hundred thousand dollars, and will postpone the completion of the dam, probably until the early summer of 1904. The Wachusett Dam for the Boston water supply has been advanced considerably during the year.

Another great hydraulic work is that which is being carried out at New Orleans for the cleansing and draining of the great southern city. It was started in 1894 as a drainage system at an estimated cost of $8,000,000; but the city, under the spur of yellow fever epidemics, increased the issue of bonds by $12,500,000, in order to complete the drainage and install a complete sewerage system. The value of this work in its effect on the health and comfort of that city will be immeasurable. The stupendous irrigation works on the Nile have been carried along with increased energy. The object of the two great dams, one at Assouan and the other at Assiut, is to store the flood waters of the Nile and use them for irrigating and reclaiming a considerable area of the Nile Valley which is capable of great fertility under cultivation. An idea of the magnitude of the task can be gathered from the fact that the river at Assouan is over a mile in width. Twenty-five thousand natives have been engaged steadily on the work in day and night shifts. The undertaking will cost $25,000,000, and will add 2,500 square miles to the crop-bearing area of Egypt, the value of which to the country is estimated at four hundred million dollars. Of that great engineering work, the Siberian Railroad, we have heard but little during the year, but the indications are that by 1903 this great artery of travel will be completed.

The construction of the new East River Bridge, of 1,600 feet span, which has advanced very slowly during the past twelve months, is taking on new life; and it is to be hoped that under the new administration, this greatly needed work will be pushed to a rapid completion. At present the Roebling Company are only just starting on the construction of the great cables. A few of the strands have been completed, but practically the whole of the suspended structure has yet to be built, to say nothing of the long approaches in Manhattan and Long Island. Work has just commenced on the caissons for the new 1,500-foot suspension bridge which is to be built in close proximity to the present Brooklyn Bridge; but this means of communication cannot be reckoned upon for some five or six years to come. The preliminary engineering is being done on the new cantilever bridge which is to cross the East River at Blackwell's Island. As a result of the determination of the Pennsylvania Railroad Company to reach Manhattan by tunnel, it would seem as though the construction of the Hudson River Bridge has been postponed indefinitely.

Other important engineering works during the year were the dredging of the 40-foot entrance channels to New York city (the 40-foot channels will be 1,800 to 2,000 feet in width and of a uniform depth of 40 feet), the completion of the Riverside Viaduct, and the opening of the Willis Avenue Bridge across the Harlem. The Riverside Viaduct, 2,074 feet in length and 60 feet in width, is a steel structure which will form an important link in the magnificent system of driveways stretching from Seventy-first Street along the banks of the Hudson River to the northern extremity of Manhattan Island, while the Willis Avenue Bridge serves to carry the Third Avenue thoroughfare across the Harlem River. The driving of the great Simplon Tunnel through the Alps has been proceeding apace; about half of the work has been done, and the indications are that the tunnel will be opened within the contract time, or during the year 1903.

An important preliminary step toward the execution of what will be one of the greatest civil engineering works of the world was the presentation of the full report of the Isthmian Canal Commission. It will be remembered that the preliminary report, made last year, set down the cost of the Nicaragua Canal at $200,000,000. The final estimate of the cost reduces this amount to $189,864,000. It is estimated that to complete the Panama Canal, with the same section and capacity of locks, etc., as Nicaragua, would cost $144,233,000. The Commission's report, judged from the standpoint of engineering and subsequent operation, is favorable to Panama; but as the latter is saddled with a demand from the owners of the Panama property of $109,141,000, the report advocates the construction of the Nicaragua Canal. For the failure of the Panama people to get a recommendation from the Commission that their canal be chosen, they have themselves to thank. As we go to press the news comes from Paris to the effect that at a recent meeting of the shareholders, they expressed a desire to sell out to the United States for whatever it considered to be a reasonable sum. If the Panama Company were willing to take for their property the $40,000,000 difference between the cost of completing the Panama and building the Nicaragua Canal, Congress would probably be disposed to take up the Panama scheme, because of its superior location and shorter length. A canal that is 46 miles long and takes twelve hours to navigate, and whose curves are few and easy, is, on the face of it, a better proposition than a canal 183 miles long which will take thirty-three hours to navigate, that is full of sharp curvature, and that will be at all times because of this curvature troublesome to navigate. These are simple engineering facts which cannot fail to govern the situation should a reasonable offer of the Panama property be made.

AUTOMOBILES.

The year 1901 will always be famous in the annals of automobilism, both on account of the mechanical developments of the automobile and the extraordinary speed records which have been made. The most remarkable records were those achieved in the Paris-Bordeaux race, when the winner covered the distance, exclusive of slow-downs, in passing through cities, at the rate of 53½ miles an hour. This performance was followed by the Paris-Berlin race, in which the distance, 744 miles, was covered by the winner in the net time of sixteen hours and six minutes, at an average speed of about 47 miles an hour. In this country Mr. Winton, driving a 40 horse power machine, covered a mile on the track in 1 minute 6 2-5 seconds, while on a mile straight away in the races held on the Coney Island Boulevard late in the year the world's record for speed was broken by several contestants, Fournier on his 40 horse power Mors racer winning the mile in 51 4-5 seconds; Foxhall P. Keene on a similar machine making the distance in 54 seconds, A. C. Bostwick on a 40 horse power Winton gasoline carriage making it in 56 2-5 seconds, and A. L. Riker covering the distance in 1 minute 3 seconds on an electric racing automobile. Mechanically, the automobile may be said to be exercising a most stimulating effect in the production of motors of great power in proportion to their weight, and every possible kind of fuel has been employed. The SCIENTIFIC AMERICAN has illustrated several of the most successful of those types. Among these we may mention a kerosene motor in which the oil is sprayed as directly as possible into the cylinder, a type which, we understand, has given very satisfactory results. The French manufacturers, who have lost none of their activity, and whose work continues to be marked by the signal success with which it has been always attended, have been experimenting with alcohol and are using it in two types of motors; one in which pure alcohol is used, the other in which it is mixed with 50 per cent of gasoline, the latter being the most common practice. In both this type and the kerosene motor, carbureters are used which are similar to those used in the ordinary gasoline motors. The French have also produced an automobile which is driven by ether, which is utilized in the same way as naphtha in a naphtha launch, the ether being boiled in a closed vessel and the resulting vapor expanded in the motor, condensed, and pumped back to the boiler. Another interesting motor is one which makes use of compressed air, the air being compressed by a kerosene oil engine carried on the carriage, and superheated by being circulated within the cylinder jacket. Theoretically this motor should show excellent economy, since the compressed air being used before it cools off, the heat of compression is not lost, and the air in circulating around the oil engine cylinders takes up much of the heat of combustion and transforms it into useful work at the axle. The progress of the industry in this country, as shown at the recent Automobile Exhibition in this city, was extremely gratifying; the form and finish of the American-made machines compared favorably with the very best work of the old, established European makers.

AERONAUTICS.

Of late years the efforts of experimentalists in the field of aeronautics have been directed rather to the airship than to the aeroplane. Indeed, the whole history of this fascinating science has been marked by a pendulum-like swing between the aeroplane and the navigable balloon. Maxim, Lillienthal and Langley are not heard from so much as De la Vaulx and Santos-Dumont. De la Vaulx has been working for a number of years on the problem of steering balloons upon the sea and during the past year he made an ambitious attempt to cross the Mediterranean in a balloon escorted by the cruiser "Du Challia." Owing to boisterous weather, the attempt was a failure. Santos-Dumont's experiments, which have attracted world-wide attention, had for their objective point the winning of the Deutsch prize of $20,000, offered to the first aeronaut who should successfully make the trip from the Aero Park in the suburbs of Paris around the Eiffel Tower and back again in 30 minutes' time. This indefatigable young Brazilian, after several attempts, in one of which his balloon was completely wrecked, succeeded in winning the prize, with only a fraction of a minute to spare. The airship in which he made the trip is 98 feet in length, 15 feet in diameter and is driven by a gasoline engine of 20 horse power. The motor and propellers are carried on a trussed frame which is suspended below the balloon by means of steel wires. Although the most notable experiments are those that have been made by gas-supported airships, a large number of less widely advertised attempts have been made with machines of the aeroplane type. Among these may be mentioned Nemethy's flying machine, driven by a 2½ horse power gasoline motor; the Hoffman flying machine, driven by a steam motor; and the Whitehead flying machine, which is built after the model of the bat,

Contemporaneously with Santos-Dumont's experiments, there have been three other attempts which are worthy of mention; one a machine built by Henri Deutsch, modeled somewhat on the lines of the Dumont machine, and the others two English machines, one built by Mr. Buchanan and the other by Mr. Bastin. Both of these are of the aeroplane type. Although the successes of the year are of scientific interest, they have not yet brought us within sight of a commercially useful airship.

MERCHANT MARINE.

In reviewing the history of the merchant marine, it must be admitted that the ship of the year is the "Celtic" of the White Star Line, which has the distinction of being considerably the largest vessel ever constructed in this or any other age. Though not so long by four or five feet, she is seven feet broader than the "Oceanic," and has fuller lines. Her gross tonnage is 20,880 tons, as against 17,274 tons of the "Oceanic," and 18,915 tons of the "Great Eastern," while on a maximum draft of 36 feet 6 inches she will displace 37,700 tons, or 14,200 tons more than the "Deutschland." She is of the mixed cargo and passenger type of moderate speed, which is becoming increasingly popular. In addition to her vast cargo capacity, she has accommodations for 2,859 passengers and a crew of 335, making a total complement of 3,194 souls. Of high-speed passenger steamers there have been added two during the year, the "Kronprinz Wilhelm" of the North German Lloyd Company, and "La Savoie" of the Compagnie Générale Transatlantique. The first named, built at the Stettin yards, is an enlarged and more powerful "Kaiser Wilhelm," 663 feet 4 inches in length, 66 feet broad and 43 feet molded depth, and of 21,280 tons displacement. She carries the four funnels, so familiar in the German ships. On her maiden trip she covered the eastward passage in 5 days 9 hours and 48 minutes, the best day's run being 540 knots at a speed of 23.3 knots per hour.

"La Savoie" is the second of a pair of handsome new vessels that the French line have lately added to their service, the first being "La Lorraine." "La Savoie," 580 feet long, 60 feet broad by 39.6 feet deep, and of 15,300 tons displacement, made her first trip to this port at an average speed of 21½ knots an hour. The dimensions of "La Savoie" are not equal to those of the largest ships of other lines, for the reason that the port of Havre imposes rather restricted limits of draft and length. The Hamburg-American flier "Deutschland" has added somewhat to her prestige by raising her average speed for the eastward passage from 23.3 knots to 23.5 knots an hour, a record which she seems likely to hold, at least until the new North German Lloyd "Kaiser Wilhelm II." makes its appearance. Unfortunately, Congress did not favor the Ship Subsidy Bill for the promotion of the American merchant marine, by which it was sought to place our shipbuilders and shipowners on an equal basis with their foreign competitors in the keen competition for maritime supremacy. Hence the finest and fastest vessels will continue to be built by foreign firms, and the cream of our passenger and freight traffic will be carried in foreign bottoms. The most notable ship to be launched during the year in this country was the "Korea," a fine freight and passenger liner, which has the distinction of being the largest steamship ever built in America. She is 572 feet 4 inches long, by 63 feet broad, by 40 feet deep, has a displacement of 18,600 tons, and was designed for a speed of 18 knots an hour. The vessel was built by the Newport News Shipbuilding and Dry Dock Company for the trade between San Francisco and Hong Kong. The "Korea" was launched in March, and the sister ship "Siberia" a few months later. The most interesting vessel launched abroad this year was undoubtedly the turbine-propelled river passenger steamer "Edward VII." This is the first attempt to apply the steam turbine to passenger service, and the results have been very gratifying. The motive power consists of three turbines working on three shafts, a high pressure in the center and two low pressures, one on each outer propeller. It is claimed that the total expansion ratio is about 125-fold. The vessel has shown its ability to maintain 20½ knots an hour in daily service; and in addition to the larger passenger accommodation due to compactness of motive power, there is a total absence of vibration. There is a decided revival of interest in the sailing ship as such, particularly in this country, where the great success of the multi-masted schooner has led to the construction of craft of this type with six and even seven masts. There is now under construction a truly mammoth schooner which will be just under 400 feet in length, 50 feet in beam, with a molded depth of 34 feet 5 inches, a displacement of 10,000 tons, and a dead weight cargo capacity of 7,500 tons. Steam donkey engines are used for handling sails on these big craft, with the result that the crew is exceedingly small for the size of the vessel, the total number of men required for this schooner being only nineteen. The type has proved to be exceedingly economical; the largest of them carrying freight at a rate considerably less than that asked by tramp steamers.

RAILROADS.

Although the work of active construction on the Rapid Transit Subway in New York has not been under way for more than eighteen months, it has been prosecuted with such diligence that the close of the year finds the contractors fully seven months ahead of their contract time. Out of a total estimated earth excavation of 1,700,000 cubic yards, a little over half has been removed; while out of a total of 1,300,000 cubic yards of rock, about 400,000 cubic yards has been taken out. If we estimate the rate of construction by the sum paid for work done, we find that out of a total contract price of $35,000,000, about a third has been paid to the contractors. The indications are that this splendid system will be open for public use by Christmas, 1903. During the year the Rapid Transit Commission decided to extend the system from City Hall Park, the present terminus, to the Battery and beneath the East River to Borough Hall, Brooklyn, and the necessary surveys are now being made.

Of scarcely less importance to Greater New York than the Rapid Transit tunnel, is the remarkable scheme of the Pennsylvania Railroad Company for connecting the Pennsylvania system directly with the Long Island roads and with New York by a series of tunnels, which will extend from New Jersey beneath the Hudson River, Manhattan Island, and the East River to Long Island. The preliminary plan, as filed with the County Clerk, calls for two tunnels running side by side beneath the Hudson River and diverging as they approach the New York side, where they extend beneath 31st Street and 32d Street to a great central station which will occupy the greater part of the blocks included between Tenth and Seventh Avenues and 31st and 33d Streets. This station will be practically a three-deck structure, consisting of tracks and platforms 45 feet below the street, a broad overhead causeway, and a vast surface station and offices erected at street grade. From the central station three tunnels will extend below the East River and reach the surface at Thompson Avenue, a mile and a quarter back from the Long Island shore. The boldness and vast scope of this scheme are characteristic of the great railroad that is behind it. It will not only afford a direct suburban service with Long Island and ultimately with New Jersey, but it will permit passengers to travel directly without change of cars from New York to the Pacific Coast or any point in the United States or Canada. Should the scheme of the late Austin Corbin commend itself, there will be an opportunity to connect the Pennsylvania system with a steamship terminal at Montauk Point. Moreover, the tunnel will give the Pennsylvania system a direct railroad connection with the New Haven system by way of Long Island and a bridge at Port Morris, thus avoiding the delay and undoubted risk of the present railroad ferriage around the Battery and up the East River. Another important work affecting the transportation problem in New York city, which is approaching completion, is the electrifying of the Manhattan Elevated Railroads. The big 100,000 horse power power-house at Seventy-sixth Street has been completed and the first engine and alternator installed. The laying of the third rail and the electrical connections on Second Avenue are also completed, and trains should be running on this division within a few days. The power house is to contain the largest stationary engines and alternators ever constructed, the former being of 8,000 horse power, and each of the alternators being 42 feet in diameter by 10 feet in width, the revolving field being 32 feet in diameter and weighing 185 tons, while the total weight of the whole alternator complete is 445½ tons. With the completion of this work the capacity of the elevated roads will be greatly increased. Ten minutes will be taken off the total running time from the Battery to 145th Street, and an additional car will be included in each train during the rush hours.

MECHANICAL ENGINEERING.

While there has been no startling development in mechanical engineering during the year, there has been a steady, satisfactory progress. Much that might be said under this heading will be found included under "Railroads," "Automobiles" or "Aeronautics," for the reason that in the field of motive power unquestionably the most interesting development has been that of the internal combustion engine. The automobile and navigable balloon, by demanding a very low ratio of weight per horse power in motors, have proved an enormous stimulus to inventors in the development of prime movers. The steam turbine, of course, continues to be the most interesting of the steam engines, and of these the Parsons type continues to hold the first place in public interest, and in the achievement of practical results. The two 1,000-kilowatt turbine plants at Elberfeld, Germany, have shown a steam consumption of 11.9 pounds per indicated horse power per hour. At the same time, the extraordinary results obtained by the "Inch" Line of steamers marks a record in economy for the reciprocating engine. Two of these vessels, the "Inchkeith" and the "Inchdune," have made the trip from Newcastle to London on a consumption of coal which worked out respectively at 0.99 and 0.97 pound per horse power per hour. These results were obtained by making use of every refinement known in steam engineering practice. Four of the five cylinders are lined and steam-jacketed, and the expansion is quadruple in five cylinders. The boiler pressure is 267 pounds to the square inch. The steam is superheated to 469½ degrees, and the air is heated to 290 degrees before entering the furnaces. The feed water is raised to 209 deg. in a contact heater and to 370 deg. in a surface heater before entering the boilers. The question next to be solved is whether it would pay to install the costly equipment necessary to secure these results on high-speed passenger steamers, and whether equally good results could be secured with a 35,000 horse power equipment as with one of 5,000. If so, we may look for quite a marked increase in the speed of fast passenger ships without any corresponding increase in the cost of running them, for it is coal consumption that is the limiting feature of these vessels. In this connection it is a significant fact that the fastest steamship in the world, and the one with the largest indicated horse power, is equipped with a system of forced hot draft, and that the engineer of the ship attributes to this system the extraordinarily large horse power that has been secured and the excellent economy of fuel which accompanies it, the consumption being 1 1-3 pounds per horse power per hour. The waste heat auxiliary engine of 150 horse power at the Technical High School of Charlottenburg, Prussia, is giving excellent results, for as a net result the steam and waste heat engine together developed an additional energy equal to 34.2 per cent of that of the steam engine alone. Moreover, the steam consumption was reduced to 8.36 pounds per indicated horse power per hour: a most remarkable result, especially when the smallness of the unit is considered. As a result of these experiments, a cold vapor engine plant has been constructed and tested in daily service at the central station of the Berlin Electrical Works in Markgrafen Strasse. The average steam consumption had been 18.35 pounds per indicated horse power per hour. When the cold vapor engine of 175 horse power was put in operation, it was found that there was an addition of 41.7 per cent to the working energy of the compound steam engine from which it receives and utilizes the waste heat in the form of exhaust steam. It is claimed at the Technical School that this dioxide-vapor engine is yet in the infancy of its development and application; and certainly in view of the remarkable results obtained, we are justified in believing that the system will have a most extended application, particularly in large central stations.

In locomotive engineering there have been no developments involving the introduction of new principles. Compounding is more in vogue abroad than here, although a new type of tandem compound has been brought out for the Northern Pacific Railway, which has been so successful that twenty new engines have been ordered from the Schenectady company. The cylinders are 15 and 28 inches by 34 inches stroke; the high-pressure cylinder being placed forward of the low-pressure cylinder, both pistons being placed on a common piston rod. Most of the new types of engines that have been produced are of the simple type, and for express service there is a preference for the Atlantic type with trailing axle beneath the firebox. The new expresses for the New York Central are the most powerful express engines in existence. Their principal particulars are: Cylinders, 21 by 26 inches; drivers, 79 inches; weight, 176,000 pounds; total heating surface, 3,505 square feet; steam pressure, 200 pounds; tractive effort, 25,350 pounds. The Vanderbilt cylindrical firebox boiler continues to demonstrate its efficiency in hard service and is being quite extensively adopted.

ELECTRICAL.

Unquestionably the most important developments in the electrical world have been those connected with telegraphy and telephony. The announcement of the brilliant conclusion of the course of experiments carried out by Dr. Pupin, in his investigation of the long-distance telephone, which appeared in the SCIENTIFIC AMERICAN during 1900, was followed by the announcement early in 1901 that he had disposed of his patents to the American Telephone and Telegraph Company for the sum of $500,000. Dr. Pupin first formulated a mathematical theory of the propagation of electrical waves, and then constructed an experimental cable which verified the theory and opened the way for the construction of a cable suitable to commercial use. Dr. Pupin's first cable was 235 miles long; his second, 500 miles; and his third and most successful cable, 250 miles in length. The inductance coils have been used successfully on a Bell telephone air line of 700 miles in length, and Dr. Pupin considers that by the use of his system telephonic messages may be sent

(Continued on page 7.)

THE MARCONI TRANSOCEANIC EXPERIMENTS.

The SCIENTIFIC AMERICAN is enabled to present to its readers the first photographs that have been taken of Marconi's station at Signal Hill, Newfoundland—a station which will hereafter be memorable as the first place where a transoceanic wireless message was received.

That the signals were received can hardly be doubted. Marconi himself has publicly stated that the signals were heard with certainty and distinctness. At the Signal Hill station a receiving wire was employed about 400 feet high, which was supported by a kite. At Cornwall, the transmitting station was provided with an apparatus which was much more powerful than that previously used for communicating at distances of 200 miles. Even with a transmitter of increased power, the signals were heard only with the aid of a most sensitive telephone receiver. Before leaving England, Marconi had made elaborate arrangements to transmit the letter S of the Morse alphabet at a certain time. From English reports it would seem that the letter was telegraphed many times without appreciably affecting the Newfoundland receiver, until the memorable Wednesday of December 11, 1901. But upon this point nothing definite is yet known. We must await the paper which Marconi has promised to read as soon as possible before some scientific society. Marconi has had unusual technical difficulties to contend with. His poles have worked very unsatisfactorily; and the balloons and kites have not given the results that he expected. In Newfoundland a pole 130 feet high has been erected with all possible care, and yet it will not be able to withstand one of the violent gales so prevalent at this time of the year along the Canadian Atlantic coast. When it is considered that the poles cost $1,200 each, how enormous is the expense of experimenting can easily be appreciated.

Photograph by James Vey.

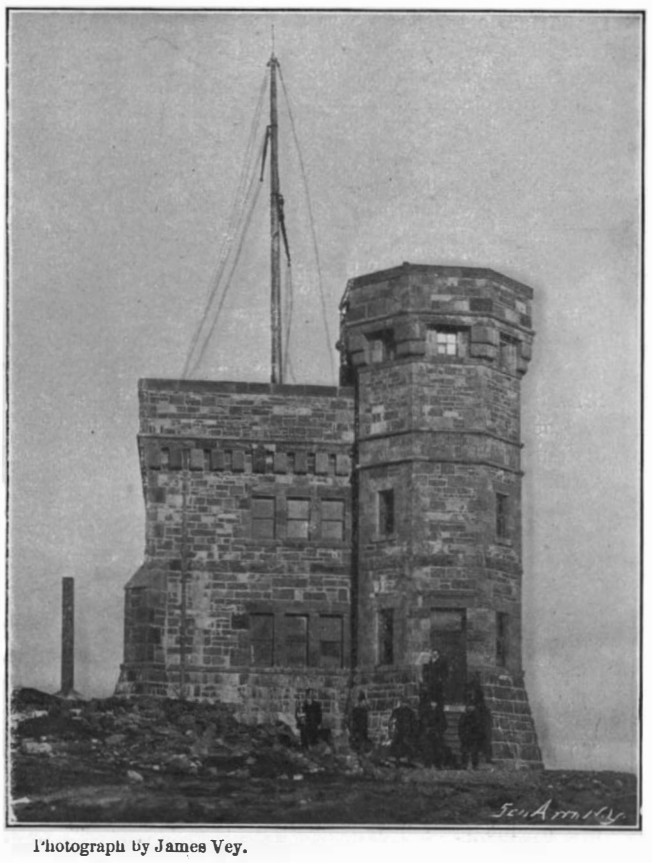
MARCONI RAISING THE GREAT KITE AT SIGNAL HILL, NEWFOUNDLAND.

At present, Marconi is endeavoring to reduce the height of the masts. But until he has solved the problem of operating nearer to the surface, he will probably construct for the purpose of his work a tower of such size that it cannot be blown down. In the experiments of Thursday, December 12, the kite was lost within one minute after the receipt of the letter "S."

The announcement of his success has earned for Marconi a popularity which is not the fortune of all inventors. The Canadian government has determined to stand by him in his fight against the Anglo-American Cable Company. Officials have honored him everywhere. At a dinner given to Marconi, Governor Boyle spoke glowingly of Marconi's achievement. Marconi replied: "If my system of wireless telegraphy can be commercially established between different parts of the earth, the possibility of which I may state I have not the slightest doubt, it would bring about an enormous cheapening in the methods of communication at present existing. The system of submarine cables of to-day fulfills the demand of communication to a great extent. But the great cost of the cables themselves and their heavy working expenses place the existing method beyond the reach of a majority of the people inhabiting the various countries of the world. But could this new method be applied, I believe the cost of what we now call cabling to England might be reduced at least twenty-fold. I do not see why, eventually, with the wireless system, this cost should not be reduced to one cent a word or less. . . . This colony of Newfoundland is the first in which a message was received by cable, across the ocean, and I am glad to say it has also been the first to receive a message across this same ocean without a cable."

Although they have unlimited confidence in Marconi's ability and rely implicitly upon his honesty, many scientists are by no means convinced that transoceanic wireless telegraphy is certain. Edison believes that success would not have been attained, perhaps, if Marconi had attempted to transmit an entire sentence. Moreover, the receiver was not the ordinary apparatus, but a telephone of the most delicate construction, and most sensitive in operation. Even with this fine instrument the signals are said to have been barely distinguishable. When these facts are kept in view, the necessity of further and more elaborate experiments and the transmission of entire messages is apparent.

The Newfoundland work is of interest technically, not only by reason of the enormous distance involved, but also by reason of the fact that the ratio of mast height to distance was not maintained. From the reports it would seem that poles were used in Cornwall no greater in height than those commonly employed for the transmission of messages for 50 or 60 miles. The curvature of the earth, formerly considered a formidable obstacle, seems to have but little effect upon the transmitted waves. Between England and Canada there is a huge curve 100 miles high. The amount of electrical energy required varies as the square of the distance. Up to the time of these last experiments Marconi had succeeded in telegraphing some 400 miles. To telegraph 1,800 miles would necessitate the expenditure of energy twenty times as great. Whether this ratio held good in the case of the transatlantic signals remains to be seen.

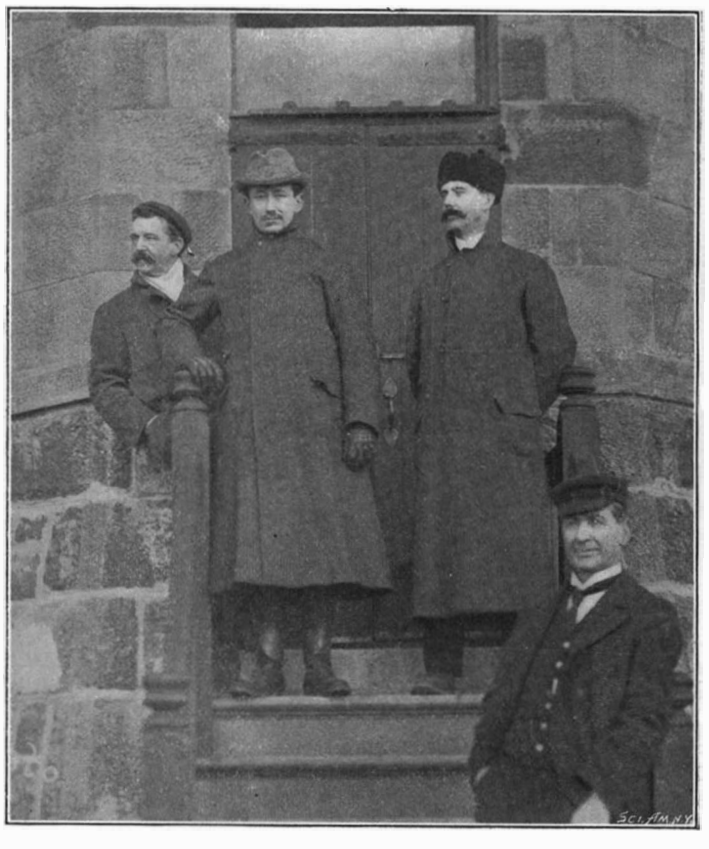


Photograph by James Vey.

CABOT TOWER, SIGNAL HILL, NEWFOUNDLAND.

Military Telephone System.

Captain Charollois has devised a system of military telephone lines which has proved quite successful, and is now used in the French and other armies. After making a number of experiments he found that a bare wire laid upon the ground, provided it was not too wet, could be used for telephone communication with earth-return over distances of several miles. The advantages of such a system in military work, where the line is to be rapidly and easily installed, are at once apparent. To diminish the weight of the line he uses a special alloy known as Martin bi-metal. The wire is 0.024 inch in diameter and weighs about 10 pounds per mile. It is rolled on flat spools of galvanized iron 8 inches in diameter and 2 inches between faces. The spools are held in the hand and the wire rolled along the ground, and the material is so light that a man on foot can easily carry 3 or 4 miles of wire, and put down the line at the rate of 2½ miles an hour. An interesting experiment has been made lately at Paris. The station was established at the Reuilly Barracks, within the city limits, and the telephone corps set out with the regiment which was on march to the Fort of Vincennes, just outside the city. It was found that the regiment could remain in constant communication with the barracks by means of a 0.04-inch wire which was placed directly upon the street, and even in this frequented part of the city it was not broken by the passers or vehicles. In the experiments which were made during the grand maneuvers in Haute Champagne by General Davoust, a wire was laid along the Bricon route between two temporary posts, and it is said that a division of cavalry and one of artillery passed along over the wire, ignorant of its presence, without breaking it or even interrupting the communication. The Charollois system is used at present by a number of regiments of the French army. In the German army it is employed even to a greater extent than in France, and nearly all the regiments of cavalry and light infantry have the outfits. The maneuvers of laying and taking up the line are often gone through with, and it is said that one company lately put down and took up as much as 16 miles of line in the same day. In the case of rain or damp soil the line is preferably hung upon trees or attached to houses, and experiments show that communication can be made up to 3 miles distance. Bamboo poles can be planted in the soil, and these form part of the regulation material. Microphone transmitters are generally used, but for less than a mile a pair of Bell telephones will work. For long distances a microphone and an adjustable receiver is best, and this has been found to work as far as 6 miles. Capt. Charollois adjusts the receiver for maximum sensitiveness by varying the distance between the magnet and diaphragm. A magneto bell or a Zigang vibrator may be used for the signals, but the inventor prefers to vibrate the diaphragm by heavy currents, using for the purpose the induction coil of the microphone, which is fitted with a vibrator. This gives a shrill noise in the receiver which can be heard in the open air as far as 300 feet.



MARCONI AND HIS ASSISTANTS AT SIGNAL HILL TOWER.

When the present work on the League Island Navy Yard at Philadelphia has been completed, the yard will be the finest in the country in the point of size and equipment. The plans call for golf links and baseball ground for the use of the officers.

THE GREAT JURASSIC DINOSAUR.

BY L. P. GRATACAP.

The distinction gained by American vertebrate palæontology has been measurably due to the extraordinary deposits in the West. The preservation of the skeletons of mammals and the great lizards is so perfect that the lessons they teach in the development of life upon our earth, and the examples they furnish of evolution quite surpass the added results of study in the same geological horizon elsewhere, throughout the world.

The Jurassic dinosaurs of Colorado and Wyoming are to be regarded as among the most remarkable of vertebrate fossils. They reveal the presence in that remote age of a group of huge terrestrial and probably partially aquatic lizards which momentarily, when we realize their great size and singular proportions, impress us as grotesque nightmares.

At that time over the depressed and in places inundated lands of the West, sluggishly moving their enormous bodies in swamp lands, and through low brake-covered uplands, were the great Diplodocus, the Morosaurus, over forty feet in length, the Stegosaurians, with their crest of bony plates, the bird-footed dinosaurians incongruously uplifted upon their long hind limbs, and the formidable carnivorous reptiles, among which was the formidable Ceratosaurus. It is difficult to restore even in mental imagery the contrasted conditions of the Jurassic age in Wyoming and Colorado when these impossible creatures were the animal monarchs in a landscape curiously different from the present in these Western States. Cycads, conifers, ferns, and equisetæ (horsetails) characterized the vegetation, a humid and warm climate prevailed, indented shore lines marked the coast of the Jurassic continent, and in harmony with the strange occupants of the land the swimming mosasaurs, or marine reptiles of great size and strength, disported in the open sea or basked in the shallow waters of estuarine bays.

The Dinosaurs comprise perhaps the largest land animals that have ever existed. They varied greatly in size, and from cat-like proportions reached the incredible dimensions of the *Brontosaurus*, whose total length may have been over 60 feet. The front legs were shorter than the hind ones. Williston suggests that their skin was probably bare, without scales or bony plates except in a few instances. Their variety of nature, form and construction was further shown in some genera having bones more hollow and lighter than with birds, while others were of the massive and ponderous type shown in the skeleton now exhibited in the American Museum of Natural History. Again, some species were characterized by horns placed upon their heads over three feet in length, and this unique ornament rose above a tremendous skull seven feet in length, five feet in width and as many in height.

The Dinosaurs have been separated into two broad divisions, the herbivorous and carnivorous dinosaurs, and to the former belongs the great Brontosaurus here shown. The dinosaurs ranged in time from the Triassic to the Cretaceous and their distribution over the earth's surface has been almost universal, Australia alone being excepted.

Among the many eventful expeditions sent to the fossil-bearing beds of the West, under the direction of Prof. Osborn, that of 1898 to Wyoming claims distinction. It was then that in the midst of the eroded outcroppings of the Jurassic limestones and marls the series of vertebræ which form the colossal backbone of the Brontosaurus were found.

These bones were taken out *en bloc* in the field, from their position, and, retained in the enveloping matrix, shipped to New York, where a corps of skilled workmen under the supervision of Mr. A. Hermann finally extricated them from their stone sepulcher in the most perfect condition. The field work was directed by Messrs. Peterson, Granger and Gidley, with whom Dr. J. L. Wortman was formerly associated as director. There has, indeed, under Dr. Wortman's suggestion, gradually evolved a very satisfactory method of taking up the specimens, packing and removing them from the matrix. First they were covered with thin sheets of muslin or of tissue paper, stuck on with gum-arabic water, over which strips of gunny sacking were bound; these were covered over with plaster and the whole, thus rigidly retained, was shipped without danger of dislocation.

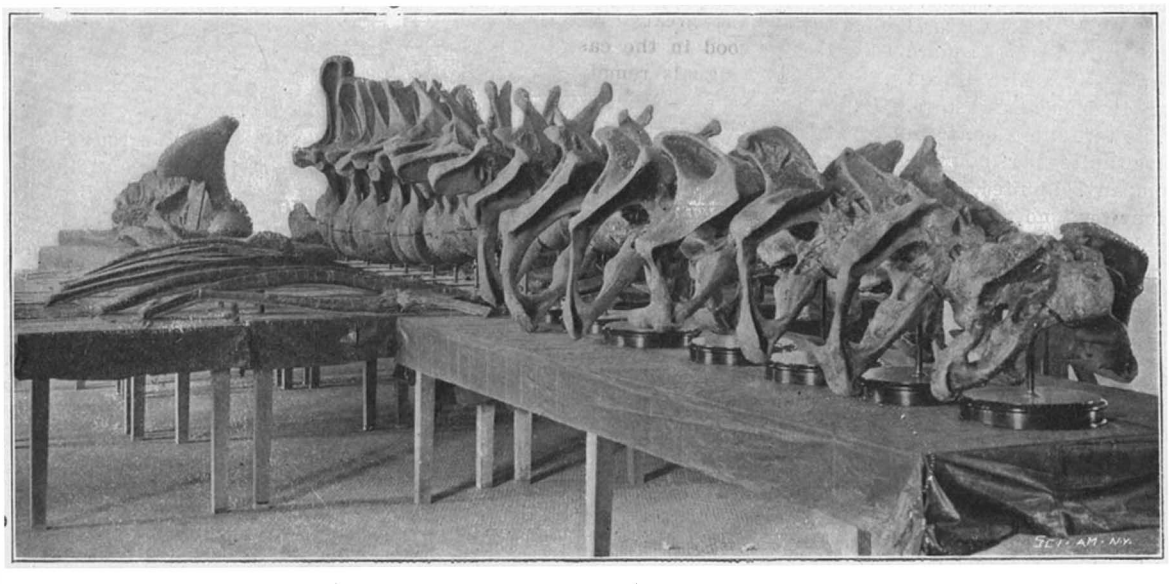
METHOD OF PREPARING FOSSIL BONES FOR SHIPMENT.

The observations of Prof. Osborn upon *Camarasaurus* would seem quite applicable to Brontosaurus. We learn from this authority that this dinosaur was, in all probability, "a great wading and swimming quadruped, enjoying a habitat similar to that of the Upper St. John River, Florida, at the present time, namely, a relatively firm bottom gently graded to all depths, supporting a richly luxuriant aquatic vegetation, the river banks bordered by sloping shallows of sand or clays."

It is also surmised that the animal could walk along the bottom with the forward part of his body raised, that it could even swim, that feeding was done in the water and along the shores, that perhaps its visits to the land were for breeding or egg-laying, that it was exposed to and suffered from the attacks of the carnivorous dinosaurs, and that by means of its powerful spines and through the qua-qua versal movement of the vertebræ the anterior part of the body could be raised or lowered.

A very interesting and suggestive painting by Mr. C. R. Knight reproduces a scene of the Jurassic continent, richly clothed with vegetation and bordered by a swampy area, in which the half-emerged bodies of these gigantic lizards appear, with stout necks raised in the air, while a browsing companion on the mainland affords an instructive hint as to their quadrupedal position with arching back and extended head and tail.

COMO BLUFF, WYOMING (UPPER JURASSIC) SHOWING INCLINED STRATIFICATION WHERE GIGANTIC FOSSIL WAS DISCOVERED.



VERTEBRÆ, RIBS, AND PELVIC BONE OF BRONTOSAURUS RECENTLY PLACED IN NATURAL HISTORY MUSEUM, NEW YORK.

Bagdad Railway.

A new railway branch, known as the Bagdad line, is to unite the Bosphorus with Persia and will traverse the whole of Asiatic Turkey. It is to be constructed by a German company. The present line is to form part of a system which will ultimately connect Europe and India. There are now in Asiatic Turkey, especially in the Anatolia province, about 1,600 miles of railroad. The principal line of this system starts from Haidar Pacha, near Scutari. When the projected Bosphorus bridge is constructed, it will form the prolongation of the great European artery which ends at Constantinople. This line runs along the Marmora Sea and the Sakaria River to Eskisher, where it branches; one branch goes toward Afrium-Karahissar, a center of opium commerce, and Konia, the Holy City of Asia Minor, which forms the terminal station. The other branch passes east to Angora. The new Bagdad line is to join the Anatolia system first at Angora by a strategic line, of which the Turkish government has reserved the construction, and second, by a German line which will lead from Konia. These two branches meet at Diarbekr in Kurdistan. The railroad runs thence along the Tigris, passing Mossoul, the site of ancient Nineveh, and Bagdad, where it crosses the river and reaches the Euphrates at a point where the ruins of Babylon are found. From there it descends toward the sea and ends at the Persian Gulf, at Mohamera and the port of Kowet. A project is on foot for constructing another line in Southern Persia which will join the former, and passing along the Persian

Gulf will traverse Beloochistan and join the Indian system at Hyderabad. It is supposed that nine-tenths of the voyagers will take this line, as it is three times as short and also more economical than the sea route. In this case one can go from Paris to Tonkin in 15 days, and from Hamburg to Calcutta in 12 days. The question of local traffic is an important one, as the territory traversed has a population of over 20,000,000, and when it is united to Europe it may become a source of cereal and other food products. Cotton culture is to be rapidly developed, and the abundant sources of naphtha which have been lately discovered near the site of Babylon are to be worked.

Automobile News.

A novel and ingenious traction system is to be inaugurated upon the old Corniche Road, from Nice to the convent of Laghet, passing by La Turbie. No rails will be laid. The vehicles are to be practically large electric motor cars minus accumulators. The motor is to receive its electrical power from overhead wires. The current will be supplied from a central electrical station. It will pass through two parallel aerial wires supported by posts. One wire will be used by the ascending, and the other by the descending vehicle. Great economy of energy will thus be obtained, besides the gain of all the space, and the avoidance of the weight of accumulators. One feature of the system is the ease with which the motor-cars will make way, or pass round any carriage or other obstacle they may encounter, the connecting wire being sufficiently long to allow of such deviations.

During the maneuvers of the Second corps of the Swiss army, five automobiles were used, and the government is greatly pleased with their performance. They were all of the gasoline type, and comprised three Peugeot machines (one phaeton and two hauling wagons), one Panhard & Levassor and one Daimler. The automobiles were hired by the government at the rate of $5 per day, the latter furnishing the gasoline and other supplies. The conductors received the pay of under-officers, besides the usual amount allowed for special duty. After the maneuvers the government paid the sum of $240 for the depreciation of the five machines. Each of these had made an average of 600 miles with a consumption of 25 gallons of gasoline. It is supposed that in view of the excellent services which these machines have rendered during the maneuvers, the Federal Council will ask for the credits necessary to provide an automobile for each of the army corps.

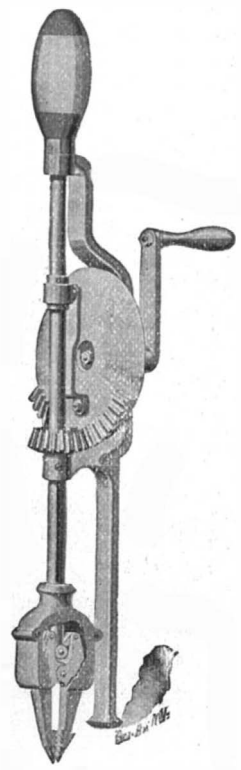
The Paris-Vienna race is to be the great event of next year. It has been decided upon at a recent meeting of the Automobile Club of France, on receipt of a communication from the Austrian Club. The latter refers to the discussion which Dr. Richard de Stern, representing the club, had with Baron de Zuylen, President of the French Club, upon this subject at Berlin, and thinks that after the Paris-Berlin, the Paris-Vienna race would be next in the order of progress. It proposes to choose the route from Paris by way of Switzerland and Bavaria, to Salzburg and Vienna. If the authorities forbid the race in France, it is proposed to proceed as far as the frontier as simple tourists and from there commence the race proper. At Vienna will be organized a series of automobile fêtes, including a mile and a kilometer dash. This communication was received with enthusiasm by the Paris Club, and the date fixed for the beginning of July next. The details of the race will be decided later.

The results of the extensive trials of motor vehicles held at Liverpool last June under the auspices of the Liverpool Self-Propelled Traffic Association have been issued. There were four classes for competition and the judges have made the awards as follows: Class A (load 1½ tons, tare two tons, platform area 45 square feet, speed eight miles per hour)—G. F. Milnes & Co., Balderton Street, London, gold medal. Class B (load five tons, tare three tons, platform area 75 square feet, speed five miles per hour)—Lancashire Steam Motor Company, Leyland, near Preston, Lancashire, gold medal. Class C (five tons, no tare limit, platform area 95 square feet, speed five miles per hour)—Thornycroft Steam Wagon Company, Limited, Chiswick, London. Class D (load four tons, no tare limit, platform area not specified, speed five miles per hour)—Thornycroft Company, gold medal; T. Coulthard & Co., Limited, Preston, Lancashire, gold medal; Mann Patent Steam Cart and Wagon Company, Limited, Leeds, silver medal. In the course of their report upon the trials the judges state that there is a gradual and marked improvement in the construction and behavior of heavy motor traffic vehicles since the first trials held three years ago and reliance may be placed upon the systems to which gold medals have been awarded for regular employment in general haulage operations, where due care and supervision are exercised. The system to which a silver medal has been awarded will give satisfactory results, subject to the points named in connection with the awards.

A SIMPLE MECHANICAL NAIL-PULLER.

It has never been an easy matter, even with the most approved appliances, to draw the fastening-nails of boxes or the like. Mr. John B. Salo, 445 W. 50th St., New York city, has devised a nail-puller of ingenious form, designed to afford a ready means for extracting nails.

The device consists of a frame from which a leg extends downwardly to be engaged with a box from which a nail is to be drawn. A draw-rod is held to slide in the frame and in a tubular handle carried by the frame. A horizontally-journaled crank-shaft mounted in the frame carries a segmental bevel-gear meshing with a bevel-pinion which rotates with the draw-rod, but is splined thereon so that the draw-rod can be raised without affecting the pinion. A lug on the draw-rod is connected by a link and wrist-pin with the segmental bevel-gear. At its lower end, the draw-rod is provided with pivoted jaws inclosed in a shell and connected at their upper ends by links. The jaws have their inner surface corrugated in order to grasp the nail firmly, and their outer surfaces formed with auger-like threads.

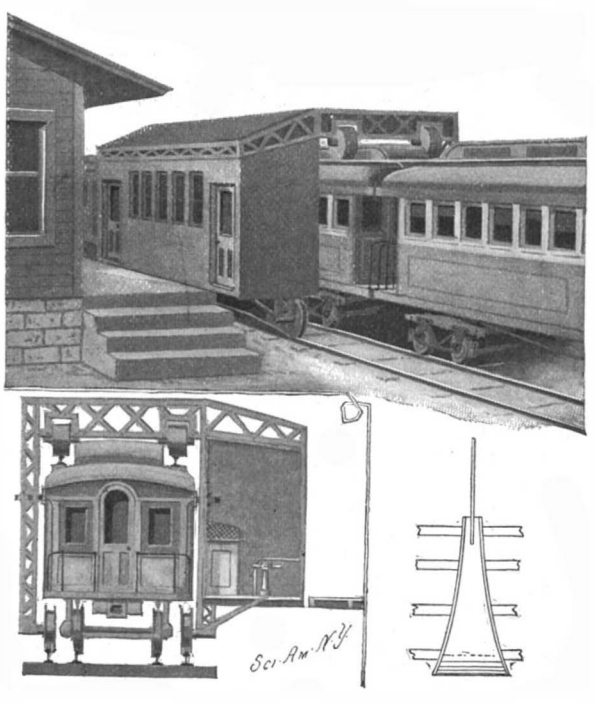


THE SALO NAIL-PULLER.

In drawing a nail, the leg is placed upon the box. Grasping the handle with one hand and rotating the crank with the other, the jaws, by means of their auger-like formation, will be fed into the wood until the toothed portion of the segmental bevel gear has passed the pinion. Thereupon the link connecting the bevel-gear with the draw-rod will cause the draw-rod to move upward, causing the jaws tightly to engage the head of the nail, so that as the rod moves upward the nail is pulled.

METHOD OF UNLOADING PASSENGERS FROM MOVING TRAINS.

Among the patents which have been recently granted in the United States may be mentioned one issued to Mr. John W. Jenkins, of 124 Front Street, New York city, for an interesting system whereby passengers are to be discharged from a train without the necessity of stopping at stations. The characteristic feature of the invention resides in the employment of a number of "saddle cars," which are successively taken up and dropped from the moving train and through the medium of which passengers may enter or leave a train without interrupting its movement.



METHOD OF UNLOADING PASSENGERS FROM MOVING TRAINS.

The railway cars employed are of the usual construction. Each car is provided on its roof with two rails, and the cars run on standard rails commonly employed. The rails on the roof of the car have their ends projected beyond the ends of the cars and grooved laterally, so that the continuity of the track formed on the roof of the cars will not be broken on a curve. These roof rails serve the purpose of receiving the saddle car. Alongside of the rails upon which the passenger car runs are arranged two rails which receive lower flanged wheels on the saddle car. These auxiliary track rails do not extend continuously throughout the length of the railroad track, but are located only at the stations at which it is desired to load and unload the passengers. The auxiliary track rails are each provided with raised portions adjacent to the ends toward which the car is moved, and the ends of these auxiliary rails are tapered. The saddle car itself consists of a skeleton-like structure which is designed to straddle the passenger cars so that the train may pass thereunder. The saddle car also includes a compartment by which the passengers pass to and from the train. The saddle car at its top is provided with broad-faced wheels which are arranged to run on the roof rails of the passenger car. When these broad-faced wheels are engaged with the roof rails, the saddle car will be lifted off the auxiliary track rails, but the raised parts of these auxiliary rails are sufficiently elevated to lift the entire saddle car from the passenger train when the lower wheels of the saddle car engage the high parts of the auxiliary rails, and in so raising the saddle car, to lift the upper broad-faced wheels off the roof rails. As our illustration shows, the roof rails on the front of the car are tapered downward so that they will readily engage under the broad-faced wheels. One of the saddle cars is to be placed at each station on the road. As the train approaches the station, the tapered ends of the roof rails will run under the broad-faced upper wheels of the saddle car, and the saddle car will be lifted off the auxiliary track rails and carried away with the train. The saddle car will ride along the top of the train, and by the time it has got to the last car will have assumed the momentum of the train. The saddle car and train will be locked together, and then the passengers can pass from one to the other. As the train approaches the next station, the lower wheels of the saddle car will engage the raised part of the auxiliary rails and the saddle car will be lifted off the train, thus permitting the train to pass on and leave the saddle car at the station. When the saddle car is thus dropped, the train immediately runs into a second saddle car placed on the other end portions of the auxiliary track rails and takes the second saddle car up with its passengers. This operation is repeated at each station, one saddle car being left at each station and one saddle car being taken up. By this arrangement the train may move without a stop through the length of the road. The saddle cars, of course, are provided with brakes to arrest their movement at the desired point.

The inventor claims various merits for his system, of which we may be permitted to mention a few. The number of cars to be used for a road materially reduces the number of trains, by reason of the increased speed. That the running time of the train over the road will be very considerably shortened, is self-evident. Moreover, one train will be able to make many trips in a day. This system is to be used not so much for interurban traffic as for suburban traffic, for the purpose of enabling residents without the city to reach their destination as quickly as possible. The effect on the value of real estate is also not to be underestimated.

Preserve Your Papers.

By taking a little trouble, when a paper first comes to hand, it may be preserved to form a permanent and valuable addition to the reading matter with which all families and individuals should be supplied. We furnish a neat and attractive cloth board binder, which will be sent by mail, prepaid, for $1.50. It has good strong covers, on which the name SCIENTIFIC AMERICAN or SCIENTIFIC AMERICAN SUPPLEMENT is stamped in gold, and means by which the numbers may be securely held as in a bound book. One binder may thus be made serviceable for several years, and when the succcessive volumes, as they are completed, are bound in permanent form, the subscriber ultimately finds himself, for a moderate cost, in possession of a most valuable addition to any library, embracing a wide variety of scientific and general information, and timely and original illustrations. Save your papers.

The Current Supplement.

The current SUPPLEMENT, No. 1357, has for its leading article "The Building of Modern Locomotives," accompanied by a number of most interesting engravings. This is the first installment. "The Practical Building of Lowland Protections" is by Percy H. Wilson, and is accompanied by elaborate diagrams. "Mechanical Shipment of Coal" describes an ingenious method adopted on the Continent. "Weight and Capacity in Locomotives With Vanderbilt Boilers and Tenders" gives valuable information relative to this interesting type. "Physiology" is one of the opening addresses at the British Association and is by Prof. John G. McKendrick, M.D., LL.D., F.R.S. "Recent Excavations of the Temple of Aegina" is by Prof. Rufus B. Richardson. "Relations Between Geology of Petroleum and Its Origin" is a particularly timely article. The usual Trade Notes and Receipts and Trade Suggestions from United States Consuls are published.

RETROSPECT OF THE YEAR 1901.

(Continued from page 3.)

over a 3,000-mile cable. The year has served to bring prominently into notice and see firmly established the Burry and Murray telephone systems, both of which are of the page-printing type. The Murray system has been adopted by the Postal Telegraph Company, and it has achieved a speed of as many as 130 words per minute. The Burry system is particularly adapted to city work, for the distribution of news from a central to a large number of outlying offices. During the year the contract was placed for the construction of the Trans-Pacific Telegraph cable, connecting Australia direct with England, via Canada. The cable will run from England to Vancouver, thence to Queensland and New Zealand by Fanning Island, Fiji and Norfolk Island. Its total cost will be just under $10,000,000, and it is to be completed by 1902. In the telegraphic world the most worthy events have been those connected with the development of the Marconi system of wireless telegraphy, which has been successfully applied to warships and to the vessels of the merchant marine. Incoming ships have been reported off Nantucket, and put in communication with New York several hours before their voyage was completed, while passing ships of the Cunard Line have picked each other up in mid-ocean and have communicated until they were as much as 190 miles apart. In the closing days of the year Marconi succeeded in sending wireless telegraph messages from the coast of Cornwall to Newfoundland, over 2,000 miles of ocean. He arranged that the letter *S* should be repeated at stated intervals, and he has announced to the world that the letter was heard by means of a delicate telephone receiver at the prearranged intervals of time, and at the hours predetermined upon. In electrical traction the most interesting work has been connected with the development of the Ganz system, in which current of the high potential of 3,000 volts is employed directly to the motors. The most important installation is that of the Meridionel Railway Company in Northern Italy, on which this new system is employed. The experiments on one of the German government roads in high-speed electrical traction, in which three-phase system high-potential current is used direct at the motors, has had some successful preliminary trials, in which a speed of just slightly under 100 miles an hour has been achieved.

NAVAL AND MILITARY.

We have so recently described our progress in naval matters in the Special Edition of the SCIENTIFIC AMERICAN that it is not necessary to do more than refer the reader to our issue of December 14, on the Development of our Navy since the War with Spain. The most noted military success of the year was the complete destruction of a 12-inch Krupp plate by 12-inch high explosive shells. So effective were the filler and the fuse that 20 pounds of government high explosive was carried into the plate and burst as it was passing through, with the result that the plate was smashed to fragments. The Gathmann torpedo-shell, containing 500 pounds of guncotton, fired at a similar plate, failed to produce results that were in any way comparable.

BREAD-MAKING BY MACHINERY.

Although the art of making bread dates back to the most remote period of civilization, only within the last fifty years have its scientific aspects been systematically studied. With the classic labors of Liebig in the chemistry of fermentation, bread-making was radically changed. The baking of a loaf was no longer a matter of individual skill, but of scientific knowledge. By reason of this change of method the little cellar-bakery, in which bread of poor quality was only too often made, began to give place to the modern factory-bakery equipped with elaborate machinery and with ovens of improved construction. The result has been that bread has been vastly improved in quality and is now made in accordance with certain well-established chemical rules. To illustrate the methods which are followed in a well-equipped modern bread-factory, the present article is devoted to a description of the Fleischmann Vienna Model Bakery, which supplies New York with a large portion of its bread.

The raw material employed in the making of bread at the bakery in question consists principally of flour, yeast, milk, and water. For the finer varieties of bread, butter is used. The flour is piled in sacks to the number of six thousand in a large storeroom occupying the topmost floor of the factory building, and is composed of spring wheat, winter wheat, and pure rye. Although modern milling machinery has done much to improve the quality and cleanliness of flour before it reaches the consumer, the baker finds that it must be still further cleaned before it becomes fit for his purpose. Consequently an elaborate cleaning apparatus or "dresser" is employed, invented by the late Jonathan Mills, which so thoroughly refines the flour that even the finest fibers of the sack are removed in passing through the machine. The cleaning apparatus comprises essentially a system of hoppers, screens, conveyers, and bins.

The hoppers are located at one end of the flour-storage room; and into their mouths the flour is poured. At the lower tapered end of each hopper an adjustable rocking closure is suspended by rods, which closure permits the passage of a definite amount of material. As the rods swing from side to side the closure rocks and permits the flour to drop into a spiral conveyer, by which it is transferred into a rotary screen. As the flour is whirled around and mixed in this rapidly-turning screen, it is driven by its centrifugal force toward one end of the screen; but before it reaches that end it has sifted through the meshes. The foreign matter and impurities are left behind, and these alone emerge from the end of the screen, left open for that purpose. The sifted, cleaned flour is transferred by a screw-conveyer, mounted immediately below the rotary screen, to a bucket-elevator, by which it is raised to the flour-storage room and conveyed to four bins by way of separate chutes. As the one bin receives its charge, its chute is closed, so that the next bin may be filled. This cleaning apparatus is constantly in operation; for during a working-day some 200 barrels of flour must be refined.

The four bins in the storage-room are situated directly above four dough-mixing machines on the floor below. And to each mixing machine the flour is carried by a small screw-conveyer and a flexible pipe-like chute from the superposed bin. Above each machine is a tank in which cold and hot water are mixed until a temperature varying from 90 deg. in summer to 95 deg. in winter is attained. Into each mixing-machine 60 gallons of milk and water, previously mixed by a baker, 840 pounds of flour, 15 pounds of salt, and a suitable amount of yeast, are introduced to form what is technically called a "sponge." In the making of rye bread caraway seed is also mingled with the other material. For the finest varieties of bread, milk and butter are used, as we have already remarked.

Although the four mixing-machines differ somewhat in detail, the main elements of the construction are the same in all. Each machine comprises essentially an iron vessel mounted to swing, in which a double spiral dasher or mixer is mounted, and is turned through the medium of gearing driven by a belt and pulley from a countershaft. When the mixing-machine has received its charge of material, the belt is shifted from a loose to a fast pulley, whereupon the dashers turn and knead the sponge into dough. Human hands could never knead so thoroughly and so quickly. After twenty minutes of mixing and kneading, by which the ingredients are intimately commingled into a perfectly homogeneous mass, the mixing machine is swung downwardly on its axis, and from the turning dasher the dough is cut with a long-bladed knife and collected in a wheeled trough.

Time was when this kneading and mixing was done by hand. The workmen washed their hands and cleaned their nails before kneading and handling the dough. But it is hard to knead dough thoroughly by hand; and perspiration must break out from the pores with the arduous labor. By using mechanical kneaders the dough can be mixed, thoroughly kneaded, without touching it with the hands. How great is the saving in time and labor wrought by these machines may be conceived when it is considered that the work which each performs in twenty minutes required at one time the incessant labor of two men for three-quarters of an hour.

Before machinery was introduced in the making of bread a man worked from twelve to thirteen hours a day in a large bakery and from seventeen to eighteen hours in a small bakery. At present all large bakeries, at least those of New York city, employ their men only during sixty hours per week.

The dough collected from the mixing machines in the troughs is now allowed to ferment or "raise," as it is popularly called, a process which requires about two and a half hours. After fermentation the dough is ready to be molded by hand into loaves of some forty different shapes and sizes. Adequate machines for this purpose have never been devised.

From the mixing-room the fermented dough is dropped into a molding and oven room by chutes, the rye-bread dough passing down by one way, the wheat-bread dough by another. The rye-bread dough is carried to a table in the mixing-room, cut into pieces of a certain weight, dropped into a machine called a "break," and then passed down into the molding and baking room by way of a chute to be molded and baked. The "break" consists merely of a pair of rollers placed side by side, and serves the purpose of squeezing the air out of the dough.

The wheat-bread dough, on the other hand, is subjected to no squeezing, but is conveyed directly by a chute to a table, to be cut up and distributed among the men who are to work it into its proper shape. After having been molded into loaves the dough is allowed to raise in a steam-box for one-half an hour.

In the walls of the baking-room fifteen ovens are built into which the loaves are inserted by long-handled wooden shovels commonly called "peels." The baking extends over a period of one-half to three-quarters of an hour, depending upon the size of the loaf. The interior of the ovens is lit by gas to that the loaves can be readily seen. Of the various ovens employed, a large double Werner-Pfleiderer drawplate oven should be particularly mentioned; for it constitutes a most valuable adjunct to the baking plant.

The oven in question has two heating chambers arranged in as many tiers, and two carriages, each of which receives a baking plate and is run forward and back in its chamber. Hangers of different lengths extend from the forward ends of the carriages and are curved in the lower carriage so as not to impede the upper. These arms or hangers run on rails to guide the carriage into the oven. The construction utilizes the space in front of the oven to the best advantage; for large-sized baking plates may be drawn out to their full length.

After the baking the loaves are collected, classified, as it were, and taken to the shipping room. Here they are loaded on some fifty delivery wagons and distributed throughout the city of New York.

The output of this model bakery aggregates about 43,000 loaves of bread and 15,000 rolls per day.

Correspondence.

A Universal Language Again.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 21 Mr. George Wilson very decidedly affirms that "There can never be a universal language." He supports this contention by a number of statements that call for some comment. I quite agree with his first paragraph, in which he denounces the idea of reviving Latin, as a universal language; we have to-day an international language—the English—which is spoken by probably 140,000,000 of people, and the use of which is rapidly spreading. The idea of reviving a dead language, the pronunciation of which is almost unknown, and abolishing the leading language of civilization, seems absurd. But, so far as Mr. Wilson's other reasons against a universal language are concerned, I beg to object. Unless I am utterly at sea, there is no such difference in the human vocal organs as he imagines. If there were, would it not be impossible for Englishmen to learn French, or the reverse? But I have just been taking a course of pronunciation in French, and my Parisian teacher tells me that my sole difficulty lies, not in the need of the proper organs, but in my misuse of them; and he assures me that with a little practice I shall be able to speak French as well as himself. Mr. Wilson may deny this, but there are other facts. Our Canadian Premier, Mr. Laurier, speaks English and French equally well. How could this be if his vocal organs were only fitted to speak French? But a few weeks ago, Mr. Wu Ting-fang, the Chinese representative in the United States, was a frequent speaker at a variety of meetings, and, if one thing was more patent than another, it was that Mr. Wu could speak English not only with good taste and expression, but so as to be understood by the audiences better than most of the English-speaking orators. If there were any such differences in the vocal organs, we might expect them to be exhibited in negroes more acutely than in any other persons; but it is patent that educated negroes—apart from a certain thickness sometimes arising from thick lips, and sometimes also perceptible in white people—can speak English as well as whites.

The idea that climatic differences make such a change in the use of the vocal organs as to revolutionize a language is belied by common experience. A well-educated man or woman from England, Ireland or Scotland can only be distinguished from similar persons in Canada or the United States by their generally clearer and more definite pronunciation; and it is evident that variation in vowel sounds arises from other than climatic causes. If Mr. Wilson's contention holds good, all vowel sounds involving the wide opening of the mouth would have been discarded in high latitudes. I have traveled from Halifax, N. S., to Victoria, B. C., and have addressed audiences at many cities and towns between those far-distant places; and, while I was never able to detect anything more than the ordinary personal variations, I never had the slightest difficulty in making myself understood.

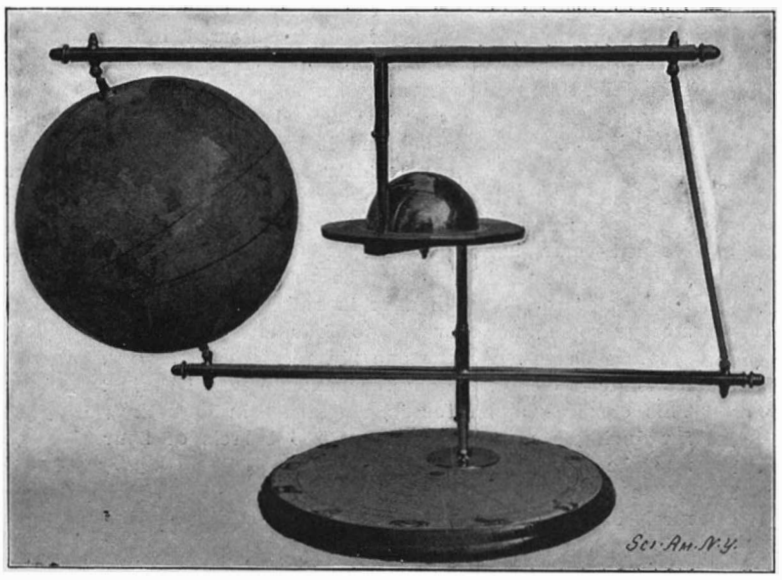
Whether a universal language be possible or desirable, I think most people will agree with me, that a language which possesses the immense literature now printed in the English tongue, which is spoken by more people than any other western language, and which is making immense and rapid strides in all quarters of the globe, bids fair to become such a language, if any one does. It might have local dialects, such as every language possesses and always has possessed; but this fact would not prevent the written and printed language being uniform, as is practically the case to-day all over the civilized world.

Toronto, December 21, 1901. J. SPENCER ELLIS.

THE CRADDOCK TELLURIAN.

An apparatus of simple, durable construction, which will illustrate in an intelligible way the earth's motion upon its axis and around the sun, the alternation of day and night, the varying length of day according to latitude and season, and other phenomena connected with the earth's motion, has been brought out by the Craddock Tellurian Company, of Knowlesville, N. Y., in accordance with the plans drawn up by the inventor, Mr. John H. Craddock. The tellurian consists of a base which supports a stationary standard, comprising two vertical portions out of alinement and connected by a cross-piece. On these two vertical portions, two parallel, horizontal swinging arms are pivoted, the pivots being so located that an imaginary line connecting them would form an angle of 23 deg. 15 min. with the vertical. The arms at one end are joined by a rod forming an angle of 23 deg. 15 min. with the vertical, and at the other end are provided with pins connected by ball and socket with a globe representing the earth. On the cross-piece joining two vertical portions of the standard rests a hemisphere representing the sun, provided with a board representing the plane of the ecliptic. The board is divided into twelve sections representing the months. The cardinal points are marked to show the direction of the earth's motion.

Our illustration pictures the conditions prevailing at the winter solstice (December 21). The tellurian clearly shows that the earth is in perihelion and that the southern hemisphere is more brightly illuminated than the northern, the direct rays falling upon the tropic of Capricorn, showing that summer is beginning in the Southern Hemisphere and that at noon the sun will be at the zenith for places on the tropic of Capricorn. An imaginary line drawn through the point of intersection of the equator with the ecliptic will indicate the division of day and night over the earth. The declination of the sun at noon can also be readily figured for any point; for instance, 23 deg. 15 min. south for any point of the equator. By turning the arms, the various phenomena occurring with the change of seasons can be faithfully reproduced. Such movement will show that the earth's axis always remains parallel to itself, that day and night are always of equal length at the equator, that at the autumnal equinox the sun is at the zenith at noon for any point of the equator, that day and night are of equal length for all points of the earth, and that the sun's rays reach both poles.



THE CRADDOCK TELLURIAN.

THE SANTA CRUZ WAVE MOTOR.

BY H. W. H. PENNIMAN.

Ever since man first sought to render useful the various forces of nature the wonderful power in the mighty waves of the ocean has excited his awe and exercised his ingenuity. Fortune after fortune has been expended to carry out the carefully calculated plans of the mechanical engineer or the fancy of the sanguine theorist. A few have worked: stockholders were elated, the inventor hilarious; but soon the sea arose in wrath, restraints of wood, cement or steel were but playthings before the storm, and by morning the contrivances of man lay a crumpled wreck upon the beach.

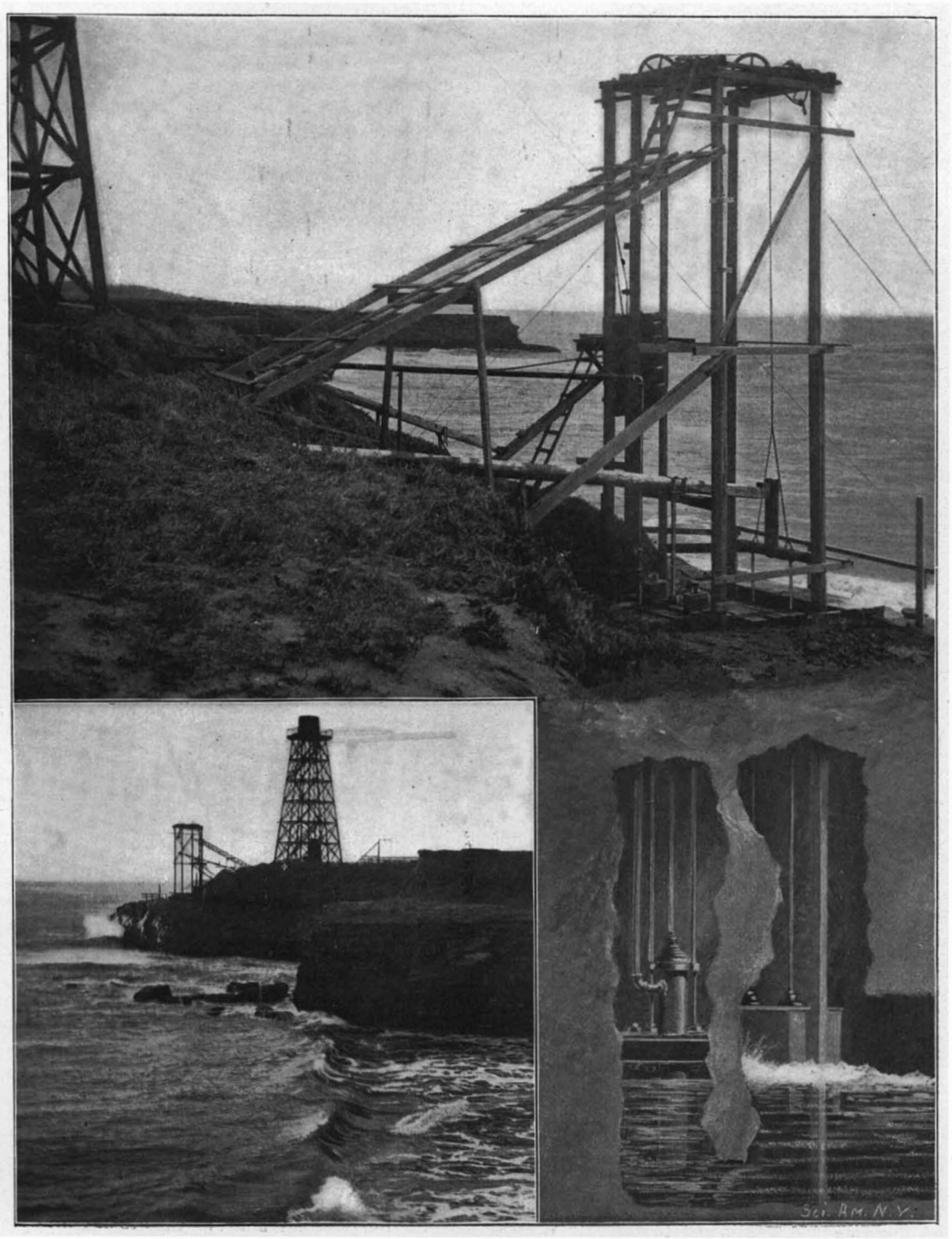
The city of Santa Cruz, California, owns what is perhaps the only practical and efficient wave motor in existence to-day, and it has stood the test of four years' operation.

One of the many attractions of Santa Cruz is the Cliff Drive, extending for four miles northerly from the city along the rugged sandstone bluffs rising in places sheer fifty feet from the breakers below, tunneled and worn by the ceaseless swell of the open Pacific.

At a point unprotected by outlying rocks or shoals two wells eight and five feet in diameter respectively were sunk in the cliff, one behind the other, the foremost but five feet from the brink. These wells extended from thirty feet above high tide to below the ebb and opened at bottom in the ocean.

The simplicity of the motor precludes a lengthy description. A counterbalanced float rises and falls between vertical guides in the foremost well as the swells outside raise or lower the water level. The plunger of a common force pump working in any part of a long pump barrel occupies the second well, forcing on the down stroke the salt water vertically 125 feet to a 5,000-gallon tank raised on a 60-foot derrick on the bank above, from whence it runs to tanks along the country roads for miles around and is used for sprinkling purposes. In ordinary weather the pump fills the supply tank in about one hour. The surplus will also shortly be utilized in the manufacture of salt.

But to return to the motor. A 35-foot, four-post derrick carries the vertical guides for pump and float which are fastened at and near the outer end of a 12-inch round timber 60 feet in length, the butt counterbalanced on the bank over two small iron car wheels rolling on a short track, and thus allowing the timber to recede and advance as well as to oscillate as its outer end follows the vertical guides. The stopping and starting contrivance, however, caps the climax for simplicity. A strong chain leads from the outer end of the beam above the float over two shelves at the top of the derrick and suspends a large barrel in vertical guides at the side. To stop the motor the barrel is filled with water from a short garden hose attached to a convenient connection from the tank. The weight of the filling barrel gradually overbalances the float, raising it above the waves. When the motor is to start a plug is pulled from the bottom of the barrel and the float gradually goes into action.



THE SANTA CRUZ WAVE MOTOR IN OPERATION.

The British consul for Siam has issued an interesting report regarding the developments of the teak timber industry in that country. The British foresters were the pioneers of this trade in Siam. As it has been brought to a high state of development and is established upon a sound basis, these foresting companies, whose invested capital aggregates $10,000,000, state that in view of the expenses and risks they incurred in opening and extending such a business as that of teak in a new field, they should receive proportionate consideration at the hands of the Siamese government and the Forest Department, now that these conditions have been changed and the forest administration and patronage has become centralized at, and controlled by, Bangkok. They also demand equality of treatment in the matter of reduced areas, increased royalties, and other new restrictions with traders of Siamese or other nationality, which form the basis of all past competition. Taking the proportion of the output for 1898-99 controlled by British subjects and other nationalities, British interests preponderate in the ratio of about 3 to 5. In response to the petitions the Siamese government has decided at the end of the year to grant to present lessees or permit-holders of areas now being worked a renewal of their leases for a further term of six years, but upon the following terms: (1) A reduction of the areas leased by one-half, the other half being considered as a reserve area; (2) the prohibition of all girdling; (3) the imposition of a royalty of 10 rupees on all logs measuring over the pikat standard of three ticals (about thirty cubic feet), and of 6 rupees on all below that size. The half-areas opened are the most productive, and should for a time afford work for the present elephant power, but no girdling being allowed, the supply of timber is limited, and must speedily be exhausted. At the commencement of the new leases, chiefly in 1902, the out-turns will be at once affected by the heavy royalty on small logs of the three ticals and four ticals pikat standard above referred to, very large quantities of which have lately been worked. The reduction of areas will, it is estimated, not affect the output until 1904. After that date, should no further girdling be allowed, the out-turn will diminish rapidly with each year of the lease. Given, however, equality of treatment with other nationalities and equality of opportunity, and provided that conservancy restrictions are as rigidly enforced against others as against themselves, British foresters and traders are entitled to anticipate, if not the same profits as heretofore, at least a maintenance in the future of the same proportion of the teak trade in their hands as in the past. As a result of the good floating season of 1900 a considerable quantity of logs, which have failed to reach the duty station, will be left in the main streams, and will swell the out-turns of 1901. Thus, with fairly favorable rains, the arrivals at the duty station may amount to 90,000 logs. After these accumulations have been worked off, a considerable diminution in the annual supply of teak from Siam may be anticipated.

An experiment is to be made at Barnes, Surrey, in lighting the streets with 700 Nernst lamps.

AN ETHER-VAPOR GENERATOR.

The idea of using a volatile body in boilers is not a new one. As long ago as the year 1852 a small flotilla of ships was equipped with what were called "combined vapor" or "binary" motors that had been devised by M. du Tremblay with the object in view of diminishing the consumption of the fuel of the engines, and consequently the capacity of the coal bunkers. The volatile liquid employed was sulphuric ether, which was vaporized by the exhaust of the steam engine, and which afterward acted in a special cylinder. The saving hoped for was realized, but an accident abruptly put an end to this process, which was seemingly so full of promise. A cylinder containing the ether necessary for the supply of the apparatus got broken in the hold of one of the vessels and the vapor disengaged at the surrounding temperature having become ignited through the flame of a lamp, during night-work, the ship was destroyed by fire. Although this accident was really not attributable to the operation of the ether motor, it nevertheless gave Du Tremblay's invention a fatal blow.

Struck by the theoretical advantages of ether over steam, M. de Susini, in 1892, resumed the study of the application of this liquid for the production of motive power, and constructed the apparatus shown in Fig. 3. Like his predecessor, M. de Susini for the heating of the ether employed the exhaust of an ordinary steam engine. The ether, after acting in a cylinder upon the surface of a piston, was sent through the pipes, *D*, *B*, *C*, into a surface condenser, wherein it became liquefied and whence it was withdrawn by a pump, which sent it to the boiler through the pipe, *A*. But it was again necessary to employ a steam engine, since M. de Susini did not dare to heat the ether directly by an open fire. The result was a great complication of parts, and the apparatus, despite the indisputable saving effected, was unable to supplant the good old-fashioned steam boiler of Papin and Watt.

But the problem seems now to be solved, for an inventor has succeeded in overcoming the difficulties that confronted his predecessors. A really practical ether generator has at length been produced, and, after its efficiency shall have been demonstrated to engineers, it will doubtless come into universal favor.

The great disproportion that exists between the theoretical work furnished in the form of heat by a steam boiler and the effective work produced by the engine has long been recognized. In other words, the real efficiency, measured with respect to the quantity of fuel consumed, is but a small fraction of the unit that would stand for the total efficiency, and the conversion of the calorific energy into mechanical is effected with a loss of nine-tenths, or, in other words, in quite fantastic proportions. This trouble is inherent in the very principle of construction of steam engines. The effective power, in fact, is obtained from the great expansion of the water in passing from a liquid to a vaporous state, followed by a contraction of the steam returning to a liquid state. Now, such differences in volume can be obtained only by furnishing the water, in the first place, with the great quantity of heat necessary for its vaporization, and afterward getting back this heat. It will be seen, then, that when the steam leaves the cylinder to flow either to the condenser or into the atmosphere, it has really restored, in the form of work, the quantity of heat which, by raising its temperature, served to carry its pressure from that of boiling water to that employed in the engine; but it has lost, without utility, the 971 British heat units furnished to every pound of water (540 calories per kilogramme) in order to cause it to pass from a liquid to a vaporous state. This loss, this absorption without profit, of valuable energy may be notably diminished by using, instead of water, a volatile liquid that does not possess such great latent heat of vaporization, such as ether or chloroform.

Thus, while water requires 2,126 British heat units (536 calories) in order to reach a temperature of 212 deg. F. (100 deg. C.), and 2,523 (636 calories) for its conversion into steam at a pressure of one atmosphere, sulphuric ether requires but 361 heat units (91 calories) for its ebullition, and, at a temperature of 96.8 F. (36 deg. C.) has a pressure of one atmosphere for a total absorption of 432.5 heat units (109 calories). The use of it, substituted for that of water in engines, would, therefore, theoretically, permit of a saving of four-fifths of the fuel required for the performing of an identical amount of work.

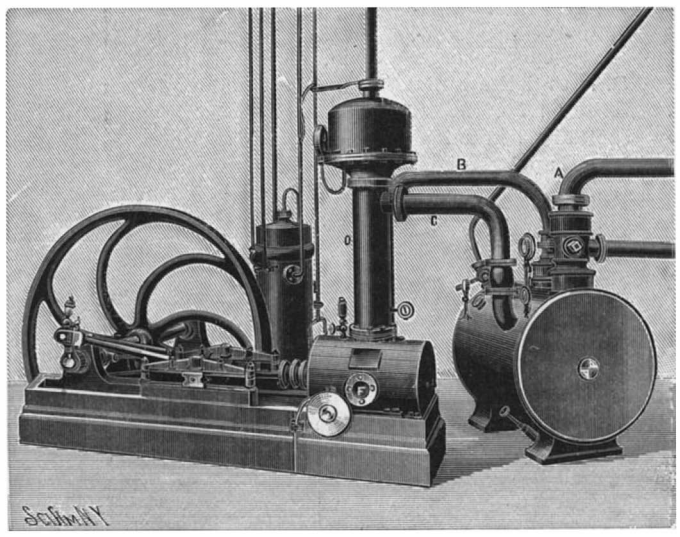


Fig. 3.—GENERAL VIEW OF THE DE SUSINI ETHER MOTOR.

But ether is a volatile liquid, against which too many precautions cannot be taken if it be exposed directly to the flames of a furnace. The pressure increases with great rapidity, and reaches one atmosphere in forty seconds. Such rapidity may prove an advantage provided unforeseen variations are automatically corrected as soon as they occur; and it is to the solution of this delicate problem that M. Desvignes de Malapert has directed himself, in order to render his generator practically inexplosive and to cause it to operate with perfect regularity.

Fig. 1 shows in section the elements composing the Desvignes ether generator. It will be seen that it possesses the general arrangement of a Belleville tubular boiler, since it consists of a series of juxtaposed tubes, *A*, held between two junction plates and inclined obliquely. The outer of these steel plates is 0.984 inch in thickness, and the inner one slightly thinner, while the two plates are set up about ¼ inch apart. The tubes of the generator are of red copper 0.078 inch thick. The holes in the plate that hold the tubes are very finely threaded and the tubes, perfectly smooth on their outer surface, are pressed tightly into the holes and then expanded with a conical tube expander, so that they fit tightly in the threads of the plate. The parts of the tubes next to the plates are also expanded on the latter, thus making a very tight joint. The heater, *E*, which is placed beneath, consists of a perforated tube supplied with illuminating gas or carbureted air, according to circumstances. This burner is fed through a valve, *F*, suitably connected with an automatic regulator operated by the pressure in the boiler.

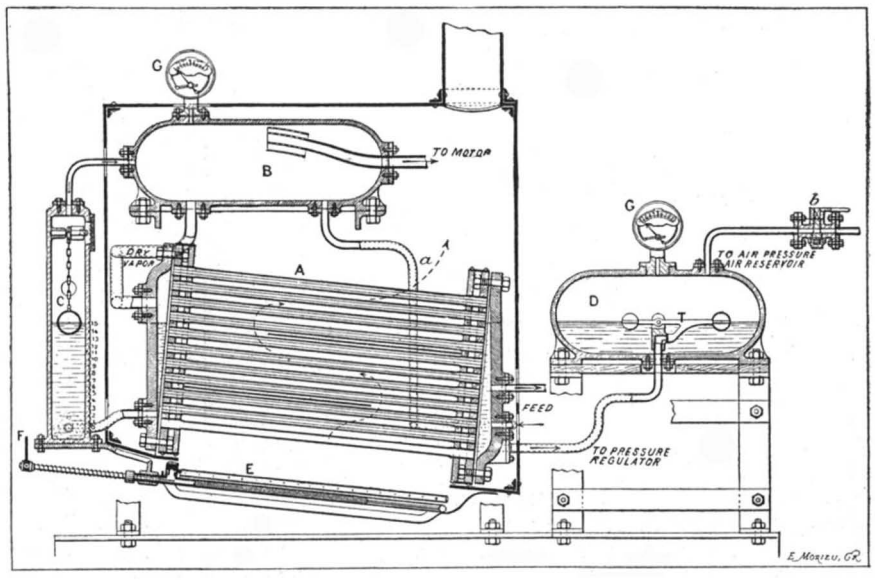


Fig. 1.—SECTION OF THE DESVIGNES DE MALAPERT ETHER GENERATOR.

A, boiler tubes; *B*, vapor reservoir; *C*, level-apparatus; *D*, pressure regulator; *E*, gasoline burner; *F*, valve for regulating the flow of the gasoline; *G*, *G*, pressure gages; *T*, float with counterweight.

The essential part, characteristic of the invention, is the feed expansion-regulator, the object of which is to limit the pressure in the generator at a point fixed in advance and thus prevent any excessive pressures. This apparatus is quite necessary as a safeguard, for the pressure increases very rapidly, and it might happen, if there were a sudden increase of heat from the fire, that the tubes would become so hot that even after the fire was turned off by the automatic regulator, the boiler would still continue to generate ether vapor under an increased pressure. The regulator consists of a closed reservoir, *D*, connected with the generator by a pipe and containing a certain quantity of ether whose level is the same as that in the generator. Before the apparatus is set in operation, air is compressed in this reservoir by means of a hand pump to the pressure which it is wished not to exceed in the generator. The pipe connecting with the generator is closed by a valve which is held upon its seat by the pressure in *D*, which exceeds that in *A*. A weight fixed upon the left hand end of lever, *T*, counterbalances a float at its other extremity. The operation of this arrangement is as follows: When the pressure in the generator exceeds the normal degree, that is to say, that of the regulator, the valve opens, and the ether is forced into the reservoir—an event that cannot occur as long as the pressure in the boiler remains below the determinate maximum. As soon as the pressure in the boiler resumes its normal point, the ether reenters the tubes till the normal level is reached. At this point the float which has been holding the valve open during the return of the liquid, allows it to close; and, as the level in the reservoir is always above the valve, no air can escape into the tubes. This arrangement affords entire security, and no explosion is possible, since the generator would instantaneously discharge its contents in case there were a superproduction of heat.

The generator is completed by an electromagnetic level apparatus consisting of a float, *C*, on the chain of which is fastened a strong magnet that moves a magnetized needle on the outside of the float chamber; and a spiral tubular condenser in which the ether returns to a liquid state after acting in the cylinders of the motor. A feed pump then sends the liquid to the generator, and the cycle of operations begins anew. The condenser, which is of small size (11.8 x 23.6 x 19.6 inches for a 10 horse power motor), is cooled either by a current of cold water or by air. In the latter case it has been found that 1 square foot of heating surface in the boiler necessitates about 1.05 square feet in the condenser with a current of air of 6½ feet per second. As ether vapor condenses very easily, it is necessary to avoid this condensation in its passage from the boiler to the motor. The copper pipe that carries the gas is therefore surrounded with a heat-retaining packing of wool covered with sheet iron, so that it is always warm and does not allow the vapor that passes through it to condense.

After trying this apparatus as a stationary engine, the inventor installed it upon an automobile frame, and found that it operated in this case just as satisfactorily as in the other.

The generator of this carriage (Fig. 2) is arranged in the rear, between the two driving wheels. Although its weight does not exceed 265 pounds, it is capable of supplying a 10 horse power motor. The tubular boiler is heated by a burner that burns air carbureted by gasoline. It is surmounted by a steam dome or reservoir. The expansion regulator is placed to the right, and the level is in front, so that the driver has the speed indica-

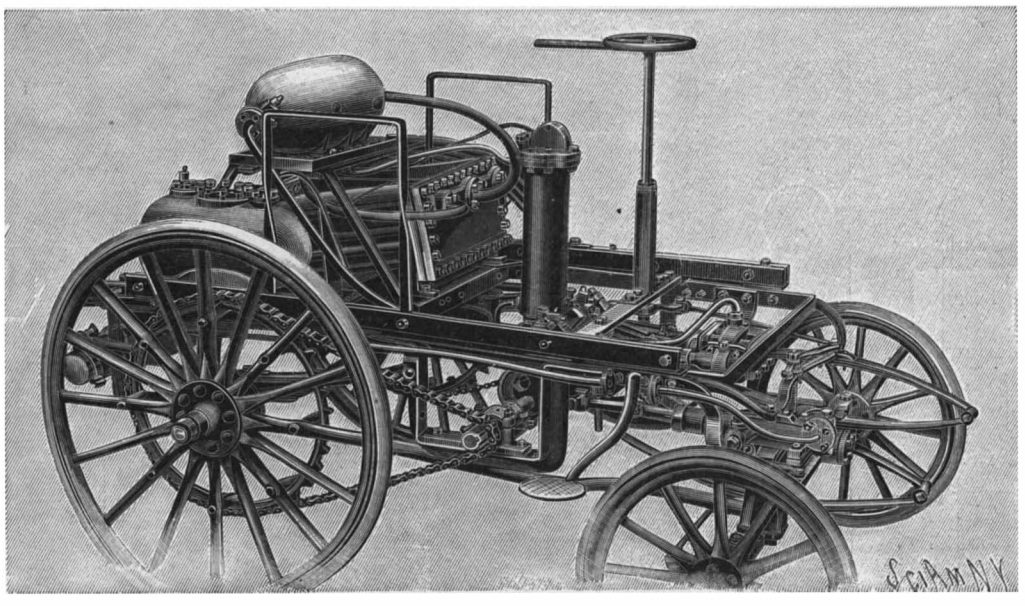


Fig. 2.—ETHER-MOTOR CARRIAGE.

tors and safety apparatus constantly under his eyes. The arrangement of this experimental vehicle is still defective, since it is far from being comfortable, and the mechanical parts are juxtaposed without any regard to appearances. But the principal point is that, although a little primitive, it has been found to operate satisfactorily. Thorough demonstration has been given of its practicability, and it can now be said that the ether motor has become practical and constitutes a new resource for the industry, the existence of which has been threatened by the constantly increasing cost of fuel. A motor of an organic efficiency greatly superior to that furnished by steam or explosive gases, and permitting of a great saving in fuel, cannot fail to be well received, especially if its mechanical arrangements are rational. Such is the case with the ether generator applied at first to navigation in 1852 by Du Tremblay, and improved and rendered practical by Desvignes de Malapert, who has succeeded in surmounting all the difficulties of the problem. Perhaps we are on the eve of a genuine industrial revolution, and shall, in a near future, witness the complete revolution of the process now in use for cheaply producing motive power.—La Nature and La Locomotion.

A NEW SYSTEM OF WIRELESS TELEGRAPHY.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An interesting new system of telegraphing without wires has been invented by Mr. Axel Orling, a young Swedish electrician, and Mr. J. Tarbotton Armstrong, a well-known engineer of London, which is dissimilar from either the Marconi, Tesla, or other systems now in use. The invention was patented long before that of Marconi, but the inventors refrained from bringing it before the public until it had been developed and brought to a satisfactory state of perfection to render it available for commercial exigencies.

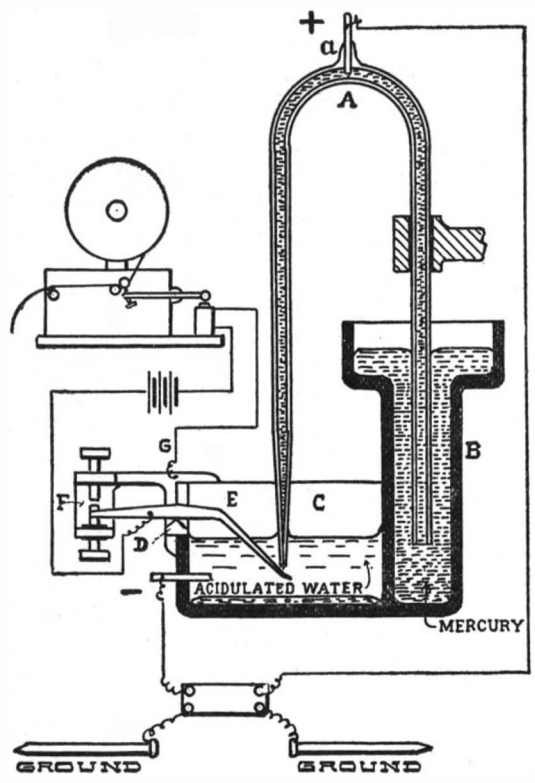
The advantages claimed for the Armorl instrument are its simplicity, portability, the low cost of installation, and facility of manipulation. The Marconi and other systems at present practised, broadly speaking, consist of discharging induced high potential currents from a transmitter into the atmosphere, finally arresting them at their destination by means of a sensitive receiver. In the Armorl system the earth is utilized as the conductor, and the currents discharged are of very low potential. The efficiency of the conductivity of the earth may be adequately realized from the fact that in order to transmit a message twenty miles, a current with a pressure of only eight volts is utilized, while even a pressure of four volts has been found sufficient to travel the same distance with complete satisfaction.

In the Armorl invention induction coils, coherers, high masts and various other impediments incidental to the prevalent systems of telegraphing without wires are entirely dispensed with. The Armorl apparatus is so small and compact that it can be compressed within the compass of a small box measuring seven inches in length by four inches in width, and eight inches in depth, and weighs from five to six pounds.

These interesting results have been achieved by the invention of a new receiver and transmitter, the former of which supplants the coherer. Hitherto the telephone receiver has been considered the most susceptible to electric currents, but this receiver has proven far more highly sensitive. It is described as the electro-capillary relay, and is an entirely new method of receiving electric currents. Through the courtesy of the inventor we are enabled to publish a sectional diagram of the device, and to describe its fundamental principles of working.

It is based upon the capilliary attraction of mercury due to the electric currents. *A* is a small glass tube with one leg terminating in a finely-drawn point, while each is open at the end. At the top of the head of the tube is a small neck, *a*, fitted with a stopper, and to which the positive wire is attached. This instrument, which is only about four inches in total height, works on the principle of a siphon. One leg is inserted in the cell, *B*, which is filled with mercury, while the other point terminates in another cell, *C*, filled with a solution of acid and water. Upon the outer edge of this cell, *C*, is fixed an agate pivot, *D*, and upon this is delicately poised a sensitive balance, *E*, one end of which descends into the cell, *C*, immediately below, and almost touching the end of the capillary tube, while the other end extends outward to a small contact point, *F*, almost touching it, and to which is attached the wire connecting to the Morse tape machine or whatever other instrument it is desired to operate. The consequence is that whenever the end of the balance in the cell is depressed, even if it be ever so slightly, it causes the outer extremity to fly upward, and to come into contact with the point, *F*, just above it. The capillary tube, *A*, is filled with mercury. The positive current wire is connected to the stopper, *a*, while the negative current wire runs to a pole in the acidulated water solution. As the current enters the capillary tube, through the point, *a*, it sets up capillary attraction of the mercury within the tube, with the result that a certain quantity of the mercury, varying according to the intensity of the current, exudes from the tube in cell, *C*, and drops on to the end of the balance. This immediately depresses this end of the beam and causes the opposite end to rise until it touches the contact point, *F*, and the current is conducted along the wire, *G*, to its requisite destination. As the balance, *E*, falls by the weight of the mercury, the latter is deposited upon the floor of the cell.

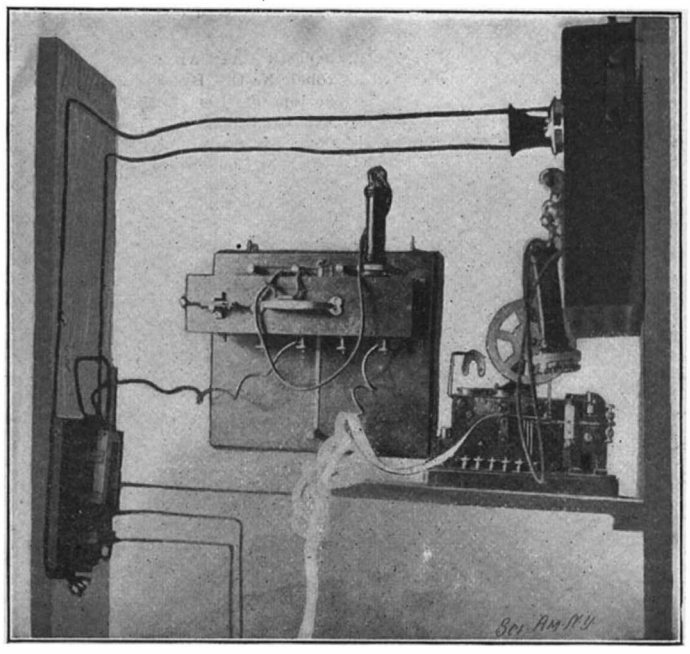
The balance of the beam, *E*, upon the agate pivot, *D*, is so delicate that the smallest quantity of mercury falling from the tube sets it in motion; and as the capillary attraction of the mercury within the tube is set up by even the faintest current of electricity, an adequate idea of the sensitiveness and delicacy of the device may be gathered. Electric currents which the most sensitive galvanometers fail to record, or



THE ARMORL SYSTEM OF WIRELESS TELEGRAPHY.

which will not affect the receiver of the telephone, will actuate this receiver, so that there is no possibility of a current entering the apparatus without moving the balance, *E*. For instance, if a cent piece is wetted, a dime placed upon it, and a wire from the coins is conveyed to the point, *a*, the faint and almost imperceptible current that is thus generated will be recorded. Another prominent feature of the apparatus also is that no self-induction is set up, which is the case with the existing type of relay. It may be contended that the embodiment of such a delicate mechanism within a portable box, which might be subjected to rough handling, would render it liable to be deranged, especially in field work, but the device is carefully and securely packed to obviate any such mishap.

The complete apparatus comprises this receiver and a small battery of eight volts packed in a case, which is provided upon the outside with two contact screws. Two pointed iron stakes are driven into the ground to a depth of approximately eighteen inches, and about twelve feet apart. To each of these a wire is attached connecting the negative and positive poles respectively of the instrument. A small key similar to that usually employed for dispatching Morse code signals is attached, together with a telephone receiver. The current thus set up flows through these wires and stakes into the ground. The operator holds a telephone receiver to his ear with one hand while he transmits the message with the other in the ordinary manner. At the opposite station, where similar iron stakes are placed to receive the impulses, if necessary, the receiver can be connected to a Morse tape printing machine, and the messages printed as they are received.



COMPLETE APPARATUS FOR WIRELESS TELEGRAPHY.

The inventors have rendered the employment of wireless telegraphic communication somewhat nugatory, however, by the discovery of a similar method of telephoning through the ground. The adaptation of this system, however, is quite recent and the results of their experiments have not yet enabled them to supply a sufficiently practicable system for commercial purposes. Although the sounds transmitted are received with perfect clearness at present they are somewhat faint, and the inventors are completing a small device for intensifying the sounds when received by the receiver.

The greatest distance over which these inventors have endeavored to transmit these electric impulses has been 20 miles with an 8-volt battery. The success of the experiments up to this distance, however, has convinced them that this is by no means the maximum distance, but at present they intend to establish this as their limit. For long distance telegraphing they have conceived an ingenious idea. At intervals of 20 miles they sink into the ground out of sight a small device enclosed in an iron box, consisting mainly of the capillary relay. The message when dispatched from the first station is arrested in its passage at the termination of the first 20 miles by this small apparatus, and then instantly, as received, dispatched on a new lease of life over the intervening 20 miles to the second relay. Thus, for instance, if it is desired to send a message 100 miles, in addition to the terminal stations at either end, there would be four intermediate relays. As each of these relays costs only approximately three dollars, the economy of the system is a strong recommendation.

If one is traveling in a conveyance, however, such as a carriage with metal flanges round the wheels, the person riding can establish and maintain telegraphic or telephonic communication, without descending from or stopping the vehicle. In this instance, the wheels take the place of the iron stakes to conduct the electric impulses from the instrument to the earth. A metal roller suspended from a metal bracket rests upon the wheel of the carriage, and to this bracket is connected the apparatus by means of a thin wire. The weight of the carriage upon the wheels ensures constant contact of the latter with the earth.

Automatic Train Signaling.

It is reported that the Pennsylvania Railroad Company is considering the adoption of an automatic electric-signal system on its locomotives, says the Western Electrician. The system was recently tested by the Chicago and Eastern Illinois Railroad, between Dolton and Momence, Ill., a distance of 63 miles. The result of the experiment was very satisfactory and seemed to show that the electric signals were far better than the ordinary block system.

In the experiments conducted by the Chicago and Eastern Illinois, the line was divided into block sections of suitable length, and adjacent block sections were separated by an insulated track section one rail in length. The track batteries were placed at these points, the positive wire leading to the insulated rail and the negative wire to the block section in the rear. The rails in each block were bonded in the usual way. In the engine cab were located two incandescent signal lamps, one white and the other red. One or the other of these is always burning. Current was supplied by battery on the engine or tender, and was switched from one lamp to the other by an instrument operated by the track circuit. Each locomotive axle had electrical connection with a conductor leading to the instrument on the engine. When the wheels entered the insulated section (if the stop signal was to be given) the current passed from the rail through the wheel conductor and cab instrument, switching the lighting circuit to the red lamp.

In this system the signal is always given two blocks back from the obstructed block, or the train-order signal, so that when the red lamp burns the engineer knows that he has one clear block in which to stop his train. The red lamp burns when a switch is open, a block section occupied or a train-order signal displayed,

The projected European plant of the J. G. Brill Car Building Company will be at Preston, one of the most flourishing cities of Lancashire, England. The new works will be equipped almost entirely with machinery from the United States and will have a capacity of 1,000 cars and 4,000 car trucks per year. About 500 men will be given employment.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CULTIVATOR.—WILLIAM H. SHERIDAN, Sadler, Tex. The invention is an improvement in a class of cultivators provided with wheels and two or more cultivating implements adapted to work in adjacent parallel rows. The cultivator is also arranged for use in turning out or digging potatoes. Various vertical and lateral adjustments can be made to suit the different conditions of work.

COTTON-SEED HULL PRESS.—WILLIAM P. WILLIAMS, Spartanburg, S. C. The press comprises a baling-chamber, in which a follower is movable. A back for the upper end of the baling-chamber is arranged to stand at an angle thereto in an extension of the sides of the baling-chamber. The extended portion of the sides and back forms a feed-chute for filling the baling-chamber with the material to be baled. Above the feed-chute is a receiving-hopper, provided with a trap-door for retaining the material in the receiving-hopper when the trap-door is closed. The trap-door forms with the back, the rear portion and bottom of the feed-chute. The machine is arranged rapidly to press the cotton-seed-hulls into very compact bales without danger of the hulls' scaling or crumbling from the bale in transit.

CLEANING AND GRADING MACHINE FOR ORANGES.—WILLIAM W. JACOBS, Braidentown, Fla. By means of this machine oranges of various sizes can be thoroughly brushed, cleaned, and graded according to their size and delivered into separate hoppers. Broadly speaking, the invention consists of a framing on which a wheel or table is mounted. A number of stationary brushes are held by the framing adjacent to the table and arranged in circular alinement. A number of rotating brushes are carried by the table and coact with the first-named brushes to form a circular tunnel or passage in which the oranges are received.

HOE.—WALTER L. MITCHELL, Collins, Miss. The tool that Mr. Mitchell has invented can be adjusted to serve either as a hoe or as a shovel. In its construction it comprises but few parts. The handle and blade portion can be cast, or the socket of the handle portion can be cast or provided with a wooden shank.

Electrical Apparatus.

TELEPHONE-RECEIVER.—FRANCIS J. ORR, Holland, N. Y. The characteristic features of this invention are a permanent magnet over the poles of which a metal plate is arranged, which is fastened at the center and at its edge. Secured to the plate are electromagnets, the cores of which rest movably against the permanent magnet. Forward of the electromagnets are diaphragms. The plate, vibrating at every impulse of the human voice, controls or causes a unison of the vibration of the two diaphragms with the plate. The plate is somewhat heavier than the diaphragms. The result is that one is able to hear clearly when the vibrations in the ordinary type of receiver are utterly unintelligible.

SWITCH-SIGNAL.—BERTIS H. URSCHEL and EDMUND P. THOMAS, Sugar Ridge, O. The contrivance relates to signals for single-track electric roads, such as are used in country districts and in which turnout switches are placed at suitable distances apart. The object is to provide a signal mechanism to be operated by a moving car in such a manner as to leave a signal light at one switch and at the same time turn on a light at the next switch ahead, and upon passing the latter switch to turn out both former lamps and turn on another lamp at the second switch and one at the next or third switch. This turning on and off of lamps is effected throughout the length of the line, thus preventing possible collisions, between switches, of cars moving in a same or opposite directions.

Engineering Improvements.

BOILER.—MARTIN F. KENELY, Elizabeth, N. J. The shell is connected with a bridge-wall chamber. At the front of the boiler-grate are corner-chambers connected by two sets of pipes with the bridge-wall chambers and forming the sides of a combustion-chamber. Another set of pipes connect the corner-chambers and are arranged in connection with the front of a boiler to form a fuel-inlet chamber to the combustion-chamber. A rapid circulation and heating of the water and economy in fuel are attained.

Illuminating Devices.

LAMP-WICK.—HENTIR SARAFIAN, Manhattan, New York city. The wick comprises an incombustible tip and an apertured cap to connect the tip with the wick. The connection of the wick with the cap is strong and secure. There are no projections liable to interfere with the feeding or adjustment of the wick, the cap being stitched or sewn to the wick.

LAMP.—AXEL L. OLSON, Essex, Conn. The lamp is of the type in which the flame is produced by gas generated from a hydrocarbon-oil. A gasoline-reservoir with a peculiarly-arranged siphon-tube serves uniformly to deliver the gasoline to a retort having baffle-cups to atomize the oil. In this retort the gasoline is vaporized by the heat from a tube passing through the retort, such tube conducting the hot gas from the lamp-burner. From the retort the gas is led to the burner of the lamp and there consumed.

Vehicles and Their Accessories.

VEHICLE.—ROLLA A. MORTON, San José, Cal. An ordinary bicycle with certain improved parts is so combined as to form a tricycle for carrying packages or other freight. Movable relatively to the bicycle is a frame, the outer part of which carries a wheel. This vehicle, comprising therefore two wheeled members adjustably connected with each other, is provided with a spring-supported motor carried by one of the members. The motor and the wheel of its member are geared together.

VEHICLE BRAKE.—BARTON W. SCOTT, San José, Cal. The momentum of the vehicle is used to furnish the principal force for the application of the brake. The brake-shoe is mounted so that it will bear on a surface disposed tangentially to the periphery of the wheel, means being provided to control the position of the brake-shoe. When the shoe is engaged with the wheel, the shoe will be pressed against the tangential surface; and this surface will then act to force the shoe more firmly against the wheel.

TIRE.—EARL C. and FRANK P. WHITAKER, Providence, R. I. The tire consists of a resilient tube with a smooth outer surface and a honey-combed inner surface, a resilient core extending through the tube and engaging the honeycombed inner surface. All the merits of the pneumatic tire are claimed, without the disadvantage of inflating the tire. Punctures are impossible.

TRACE-HITCHER.—WALTER W. MEREDITH, Akron, Iowa. By means of this device a trace can be quickly attached or released. The necessity of forming eyes in the trace, which has a tendency to weaken it, or of attaching tug-eyes to the trace is avoided. The trace can be adjusted as to length without taking it up or letting it out in the harness.

THILL COUPLING AND DETACHER.—GEORGE H. TATGE, Osmond, Neb. The object of this invention is to provide a novel simple device attachable upon the front axle of a vehicle and adapted to connect the thill-irons therewith, so as to permit their instant detachment while the vehicle is in use to prevent possible accident and injury to the occupants of the vehicle.

Metallurgical Implements.

COMBINED ORE ROASTER AND SMELTER.—PETER KIRK, Phoenix, Ariz. Ores bearing silver, lead, copper, gold must be roasted before smelting, since they contain too much sulphur, which should be reduced to seven per cent. The present apparatus effects this preliminary roasting and also the subsequent smelting continuously, with great saving in heat and labor. The invention is an improvement upon that form of combined smelting and roasting furnace in which two vertical roasting chambers communicate at the bottom with the opposite ends of the hearth of a smelting-chamber and at the top with a stack by means of a damper. The vertical roasting-chambers are arranged to operate alternately on the Siemens regenerative principle. Liquid fuel with steam can be used in roasting.

Medical Appliances.

HERNIAL TRUSS.—LOUIS ROPERS, Lincoln, Ill. The truss permits the free and easy movement of the body, so that it can be worn in comfort. To this end it consists in the special construction of the parts of the pad in relation to the body-belt and adjusting devices, and also in the peculiar nature of the body-belt itself.

HERNIAL TRUSS.—GEORGE V. HOUSE, Mount Vernon, N. Y.—The pad is readily adjustable to various positions on the front piece and can be turned in any lateral direction or moved up or down on the front piece, so as to bring the pad into the most suitable position. The pressure can be distributed on different portions of the pad.

Mechanical Devices.

ADDING MACHINE.—JAMES J. WALSH, Elizabeth, N. J. The adding machine, called the "calcumeter," is one of the smallest and most compact calculators that has ever come to our notice. The size is such that it can be very readily slipped in the pocket. The machine not only adds and subtracts, but also divides and multiplies. With a little practice problems in square root, cube root, interest, discount and percentage can be solved. In construction this machine is most durable; in operation highly efficient. We have seen formidable columns of figures added by its means with a speed and accuracy that no expert accountant could ever hope to attain. No mental effort whatever is involved in performing the necessary operation.

CRUSHER.—WILLIAM E. JOHNSON, Joplin, Mo. Mr. Johnson has devised a direct-acting crusher having no parts liable to great wear except the jaws. The movable jaw has but a slight movement with no lost motion and is so constructed that adjustments can be made while the machine is running, for crushing fine or coarse, thus resulting in the performance of a greater amount of work in a given time than is possible with crushers that must be stopped for adjustment..

METAL-BENDING MACHINE.—CHARLES B. GARDINER, and DAVID F. RANNEY, Raynham, Mass. The machine is designed to bend or form steel shanks for shoes, but can be employed for bending metal for other purposes as well. The machine is practically automatic in its operation and performs work much faster than is possible with metal-bending machines in which the blanks are fed through the dies by hand.

TURNING AND BORING LATHE.—DEFIANCE MACHINE WORKS, Defiance, Ohio. This turning and boring lathe is the invention of Mr. George A. Ensign, whose patented wood-working machinery we have frequently had occasion to notice in these columns. The present machine, an improved turning and boring lathe, is designed rapidly and accurately to produce various articles from wood, and is arranged completely to bore, turn, polish, and cut off the article from the stock, so that no further hand labor is required, the articles leaving the lathe sharp, clean, and smooth.

APPARATUS FOR SOLDERING BOTTOMS OR TOPS OF TIN CANS.—EMILE BESSE AND LOUIS LUBIN, Rue St. Lazare 97, Paris, France. The invention is an apparatus for automatically soldering tin boxes for preserved food-stuffs and the like. The can-soldering machine has a can-holder comprising an annular main portion and a relatively-thin plate or web extending throughout the area thereof and formed with openings therein adjacent to the edge of the plate. A soldering-iron is formed with upwardly-projecting portions adapted to extend through the openings in the plate to contact with the can. The apparatus serves to solder the tops or lids on plain boxes, which it would be impossible to turn upside down without disturbing their contents.

SAW-SETTING MACHINE.—WILLIAM L. HOLCOMB, Grand Haven, Mich. The machine affords convenient means for quickly and perfectly setting the teeth of a saw by bending alternate teeth of the blade to an equal degree from each side, thus setting all the teeth of a saw in one operation of the machine.

APPARATUS FOR ASSISTING IN MAKING PIANO-BACKS.—CHARLES H. BROMM, Saginaw, Mich. The invention provides a frame and clamp to hold together the parts of piano-backs or other structures during the work of assembling them. Combined with a base is a tilting-bar adapted to carry a clamping-frame and its work. Pins, carried on a hand-screw are removably engaged with the tilting-bar. The work can be forced against the gage-block, thereby bringing all the parts together in square.

CIGARETTE-MAKING MACHINE.—HENRI H. H. BOBIN, Rue de Paris, Pantin, France. The machine consists of two parts, the one intended to prepare the roll of tobacco around which a leaf of paper is to be rolled and afterward to affect the rolling of this paper in order to form the cigarette; the other part being intended to gum or fasten the paper leaf and during transit to place it in a suitable position to be engaged by the previously-mentioned mechanism for forming the cigarette.

HAY OR STRAW BALING MACHINE.—RICHARD F. MCKAIG, Wever, Iowa. The inventor has patented an automatic device for wiring bales of hay or straw in a press, particularly power and steam presses, and in connection with straw-presses adapted for attachment to threshing-machines, so that all the straw can be baled as it comes from the machine. The division or partition box usually employed is dispensed with. As soon as the bale is completed the wiring device is thrown into gear, the bale is immediately wired, and the wire is twisted and cut at the twist therein, and other wires laid for another bale.

MUSIC-LEAF TURNER.—EMIL J. MÖLLER, Maryborough, Queensland. When the musician desires to turn a leaf he has but to press a pedal on a piano, or a knee-lever on a music-stand for violin. The apparatus is constructed in such a manner that it can also turn the leaves back if repetition of the music be required. The apparatus consists in the main of a number of arms, each of which carries two upright fingers, between which the leaf is placed. The one end of the arms is placed on a vertical spindle, on which they are worked forward and backward by a suitable mechanism.

MOTOR APPARATUS.—JOHN E. TYLER, Roxobel, N. C. By reason of the peculiar construction of his motor the inventor is enabled to utilize motion given to a descending column of water in connection with a tank containing compressed air, to operate an ascending column of water in a pipe leading from the main tank containing compressed air. A water-wheel is thereby operated to impart motion to any desired machinery. The invention includes a combination of supply-pipes leading to their respective main air-tanks, a discharge-pipe leading from one of these pipes, and a compound expansion-engine, whereby the pistons, operating to give momentum to the columns of water in the several supply pipes, can be expansively operated.

FIRE-ESCAPE.—WILL B. WOOD, Shamokin, Pa. The improved fire-escape is designed to enable persons to lower themselves in safety from a burning building. In some of its features the device is applicable for use as as safety apparatus for elevators or inclined railways. The device is of the kind in which the movement of the casing over the rope, or of the rope through the casing is retarded and regulated by a centrifugal governor and brake.

AIRSHIP.—ROBERT H. BOTTS, Richmond, East Yards, Cal. The inventor has endeavored to devise a practicable, safe, and trustworthy form of airship, constructed with the lightest and strongest framework and provided with propellers for raising and lowering the entire vessel. A gas-bag of peculiar construction is employed. Steering devices direct the course of the airship. The gas-bag is of annular form and of such character that it serves during flight as an aeroplane and also, in descending, as a parachute.

TYPEWRITER.—JUAN B. VIDAL, Havana, Cuba. Mr. Vidal has devised an arrangement of keys to enable the operator readily to operate the machine with a very slight movement of the fingers. A series of depressible keys and two series of keys movable forwardly and rearwardly are provided. One of the latter series is located in advance, and the other in the rear of the depressible keys. The forwardly and rearwardly movable keys project upwardly beyond the depressible keys immediately adjacent thereto, so that a finger engaging a depressible key may, by a slight movement, operate the adjacent key of the second kind, and the latter key will form a stop to guide the finger to the depressible key.

Railway Contrivances.

DUST-GUARD.—HARRY C. TAZEWELL, Wilmington, Del. A carrier has an opening for packing devices, in which opening is a packing-ring secured to a spring-ring. One end of the spring-ring is fastened to the carrier, the other end being free. This free end of the spring-ring is operated upon to expand the packing-ring. The dust-guard efficiently serves its purpose. The packing can be conveniently renewed when necessary.

TICKET-HOLDER.—DAVID B. METCALF, Tarrytown, N. Y. To facilitate the work of the conductor and to relieve the passenger of much trouble, Mr. Metcalf intends to hold the ticket in a simple device secured to the top of the seat. The holder saves the conductor the trouble of asking for the ticket and the passenger the trouble of producing it.

AUTOMATIC SAFETY GEAR AND SIGNAL SYSTEM.—WILLIAM W. MURCH, Brooklyn, New York city. The invention is a block system for railways. The purpose is to provide an improved, automatic safety gear and signal system designed mechanically to set the signals for the different blocks or sections by the passing trains and for preventing collisions by automatically shutting off the steam and applying the brakes to bring the train to a standstill without any action on the part of the engineer, in case he should have disregarded a danger signal and should be about to pass upon a section of the road occupied by another train.

CAR-WHEEL.—HARRY C. TAZEWELL, Wilmington, Del. The invention is an improvement in car-wheels, relating particularly to the construction of the wheel. Means are provided for lubricating the wheel, securing it upon the axle, and preventing the entrance of dust between the wheel and the box.

Miscellaneous Inventions.

MARINE VESSEL.—WILLIAM NIEMEYER, St. Joseph, Mo. The vessel has a peculiar form of hull, which enables it to move through the water, according to the inventor, with less resistance than has heretofore been possible. The vessel is constructed with a square stern; and this square stern is provided with a scoop-like rearward projection, leaving an air space to avoid the suction or drag resulting from the passage of the hull through the water.

FILING-CABINET.—SAMUEL T. YOUNG, Glasgow, Ky. This filing-cabinet for deposit-slips, canceled checks, and the like, consists of a stand, a body having flat side sections, and a flange extending outwardly at the base. Opposite the flat sides are filing-pins arranged to receive the filed papers, the end edges of which rest against the flat sides. The papers may hang over the edge of the flange-plate.

APPARATUS FOR FILING CANCELED CHECKS OR OTHER PAPERS.—SAMUEL T. YOUNG, Glasgow, Ky. The apparatus consists of a frame having a series of steps on which are narrow boards, each separated from the riser in front and in the rear by a narrow space. On the boards a series of separable and vertical filing and canceling points are secured. The boards are thus spaced to permit the fingers to run along both sides for the purpose of looking up any particular check or collection of checks. Any check or voucher can be readily found at any time, so that it is an easy matter to learn the exact standing of any account.

METHOD OF PURIFYING WATER.—WALTER DERVAUX, Brussels, Belgium. It is well known that lime water can be purified by boiling, whereby carbonic acid is liberated, and calcium carbonate precipitated. This invention relates to the purification of water by the ebullition process and has for its object to provide certain improvements whereby a thorough and easily regulated physical and chemical action is obtained.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 1810.—For manufacturers of clasp buttons, such as are used on gloves.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 1811.—For the dealers in the Stengel patent casters.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 1812.—For gasoline engine castings up to 6 horse power.

Metal substitute. Crane Bros., Mfrs., Westfield, Mass.

Inquiry No. 1813.—For dealers in interlocking rubber tiles for tiling floors.

Stencil Machines.—A. J. Bradley, 101 Beekman St. N.Y.

Inquiry No. 1814.—For manufacturers of printing presses for printing advertisements on pencils.

Gasoline Lamps and Systems. Turner Brass Works, Chicago.

Inquiry No. 1815.—For a small furnace for smelting copper, from 1 to 3 hundredweights at a time, using kerosene for fuel, if possible.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 1816.—For manufacturers of aluminium or metal figures, letters and trade checks.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 1817.—For manufacturers of machines for renovating feathers.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 1818.—For manufacturers of novelties for the mail order business.

For sheet metal stampings and novelties try Standard Stamping Co., Seventh and Hudson, Buffalo, N. Y.

Inquiry No. 1819.—For manufacturers of macaroni machines.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 1820.—For manufacturers of speed indicators for obtaining the speed of an engine or pulley.

CANS.—¼ pint and ½ pint tin cans are manufactured by National Cement Co., Toledo, O. Write for prices.

Inquiry No. 1821.—For dealers in the "Bend-not" Dragon silver steel pins, made in Germany.

Automobiles built to drawings and special work done promptly. The Garvin Machine Co., 149 Varick, cor. Spring Streets, New York.

Inquiry No. 1822.—For manufacturers of games and boards on which to play them.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 1823.—For manufacturers of corn oil.

Constructor and operator of wood chemical plants, including refineries and by-product apparatus. O. A. Myers, 626 West Fourth Street, Cincinnati, Ohio.

Inquiry No. 1824.—For manufacturers of cocoanut oil.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

Inquiry No. 1825.—For manufacturers of small sets of wireless telegraphy instruments.

FOR SALE.—Handsome 24-passenger automobile coach; also 2-ton steam freight wagon. Both new. C. Francis Jenkins, 1103 H st. N.W., Washington, D. C.

Inquiry No. 1826.—Wanted, to purchase patents on articles suitable for general consumption, such as novelties, etc.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 1827.—For manufacturers or dealers in divers' supplies,

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Inquiry No. 1833.—For dealers in the electrical water heater invented by H. M. Hill.

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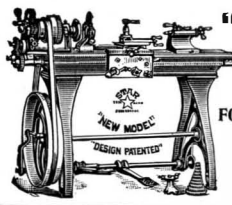

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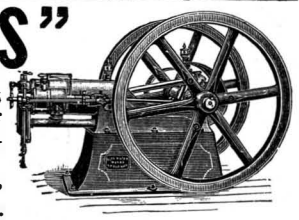

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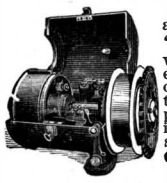

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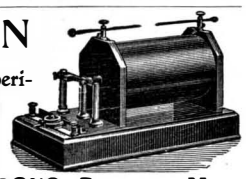

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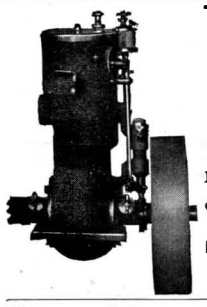

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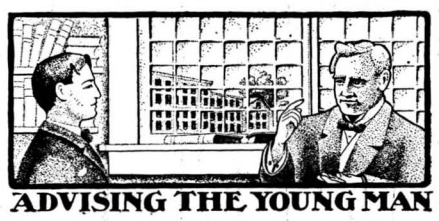

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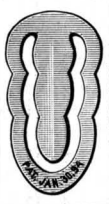

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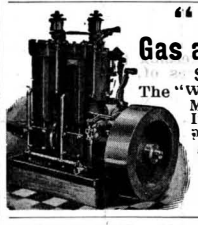

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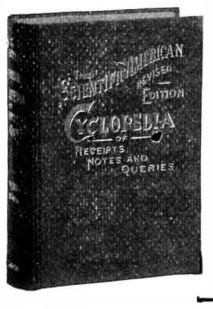

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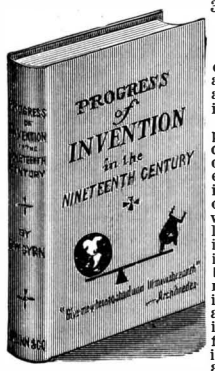

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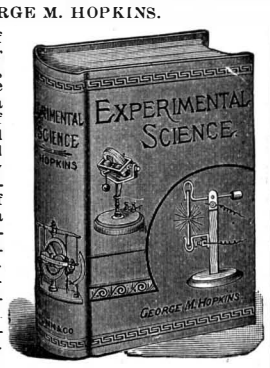

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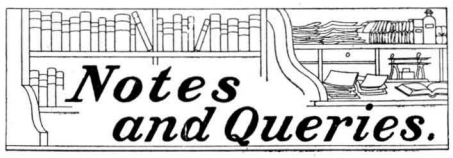

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Minerals sent for examination should be distinctly marked or labeled.

(8489) J. G. M. asks if cast iron balls and cones can be cast so as to wear, and if they cannot, kindly state what other material can be used besides steel. A. Cast-iron balls and cones are not suitable for bearings for vehicles or machines. Nothing is better than truly finished steel balls and bearings, hardened.

(8490) D. L. O. asks whether or not it was ever the general practice to build locomotives with inside cranks in this country. Kindly give the date at which inside cranks were most generally used, and state roughly the extent to which the practice of building this type of locomotive was carried. A. Locomotives with inside cranks were the prevailing type with American builders commencing about 1831, and their building continued until about 1845. They were in use mostly for switching engines as late as 1860 and possibly later. The outside crank type were also built and in use during the early period of locomotive service in the United States, and began to displace the center crank type for passenger service about 1842.

(8491) C. B. H. asks: 1. I have a good knowledge of the rudiments of electrical engineering and am desirous of completing the study as far as possible without the aid of an instructor. Will you kindly inform me what books you would recommend, also the prices and the order in which they should be taken up? A. Starting from a thorough knowledge of elementary electricity, embracing all that is contained in a book of the scope of Thompson's "Elements of Electricity," price $1.40 by mail, you should then proceed to the study of the dynamo, lighting systems, distribution systems, power systems, etc., in the direction of practical work. At the same time a study of currents, theoretically, should be carried on. Thorough work should be done upon the mathematics of the alternating current and the machines used in its distribution. You would do well to begin with Hawkins and Wallis' "Dynamo," and take next Crocker's "Electric Lighting," two vols., price $3 each. Steinmetz's "Alternating Currents," price $2.50, is the standard book on the theory of this subject. Kapp's "Transformers," $4, might follow this. For the electric railway there are many valuable books. Crosby and Bell, price $2.50; Dawson, $12.50; Bell, $3, may be named. The work thus laid out as a beginning only ought not to be carried on "by the book" alone. It ought to be taken in a laboratory where the article which is the subject of study at the time can be before the student and be handled, tested and investigated. Even a night course at one of the excellent institutions offering such courses in New York city would be far better than a book course taken without an instructor. 2. I should also like to know the method employed in figuring charges for light and power and how the wattmeter is read. If different manufacturers' instruments require

(Continued on page 15)

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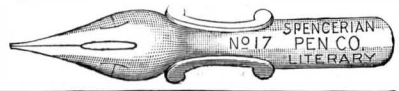

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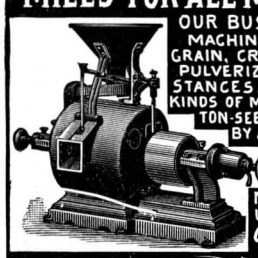

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(8492) W. H. P.—See reply to C. B. H., above.

(8493) J. C. H. asks: Will you please inform me whether there is any book treating on electrical resistance and its principles. If so, can you furnish it, and at what price? I am aware that this is treated of in various works but I want the most complete treatise I can find. A. There is no separate treatise upon electric resistance. It is fully treated as to theory in such a textbook as Thompson's "Elementary Lessons," price $1.40 by mail. The various data of metals, methods of measurement, etc., are given fully in Foster's "Electrical Engineers' Pocket Book," just issued at $5.

(8494) T. H. S., O. H. L. and others.—Several of our esteemed correspondents have taken exception to our statement regarding the fall of rain into a rain gage. One suggests that a gage would not catch any water if the wind blew so hard that the drops were driven horizontally. We should reply to that, neither would any rain fall upon the ground in that case. A rain gage would certainly catch all the rain which reached the ground in that case. The reason for the misapprehension upon this subject seems to be that our correspondents do not realize that the lines of the rain are nearer together for the same amount of rain, as for example one inch, when the lines of the rain slant. Suppose that from a rod threads are hung at equal intervals, and fastened at the same intervals to a second rod below. These threads will represent lines of rain falling vertically Now take hold of the lower rod, and draw it aside, holding the threads taut. The upper rod, and the lower as well, will still be horizontal as before. There will be the same number of threads between the two rods, but they will be nearer together. So will the lines of rain, if a breeze springs up while it is raining. A singular mistake is often made by people which arises from a similar cause. If a person goes out in a rain when it is calm, and walks fast, he often thinks it has begun to rain harder, because he is hit by more drops. His walking is equivalent to a wind in the opposite direction, and the rain drops seem to slant and to be brought nearer together. He therefore thinks it is raining harder. Our answer to Query 8404 gives a simple way of understanding the matter. We think anyone who carefully studies that answer should come to the right conclusion, that if gages were set each with an opening one foot square, so as to cover all the ground under a storm, all the rain which fell in the storm must be found in the gages, and each gage would have the rain water in it which fell upon its square foot. If less fell upon one square foot than upon another square foot, the gage would not have as much rain in it as others. We do not maintain that there is the same rainfall in all parts of a storm. Eddies of the wind may even turn the rain drops so that they rise from the earth for awhile, but we do maintain that a rain gage catches the rain which would fall upon the same area, if the gage were not there. This is absolutely true except for the eddies which the gage itself causes. If a gage is on a high tower, the tower itself causes much larger eddies of the wind, and the gage suffers from its lofty position. In a proper location, however, eddies have only a slight influence, and the gage acts in a normal manner. Rain gages have been set in the ground so that the upper edge was even with the surface of the ground, to prevent the formation of eddies by the gage. The Weather Bureau, however, does not require them to be sunk in this way.

(8495) C. G. W. says: Will you kindly inform me through your Notes and Queries column how I can artificially color a meerschaum pipe? A. Ordinarily the pipe is boiled for coloring in a preparation of wax which is absorbed, and a thin coating of wax is held on the surface of the pipe, and made to take a high polish. Under the wax is retained the oil of tobacco, which is absorbed by the pipe, and its hue grows darker in proportion to the tobacco used. A meerschaum pipe at first should be smoked very slowly, and before a second bowlful is lighted the pipe should cool off. This is to keep the wax as far up on the bowl as possible, and rapid smoking will overheat, driving the wax off and leaving the pipe dry and raw. A new pipe should never be smoked outdoors in extremely cold weather. Fill the pipe and smoke down about one-third, or to the height to which you wish to color. Leave the remainder of the tobacco in the pipe and do not empty or disturb it for several weeks, or until the desired color is obtained. When smoking, put fresh tobacco on the top and smoke to the same level. When once burnt the pipe cannot be satisfactorily colored, unless the burnt portion is removed and the surface again treated by the process by which meerschaum is prepared. The coloring is produced by action of the smoke upon the oils and wax which are superficially on the exterior of the pipe, and are applied in the process of manufacture.

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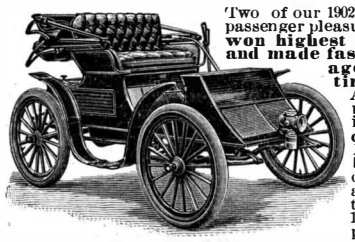

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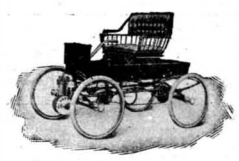

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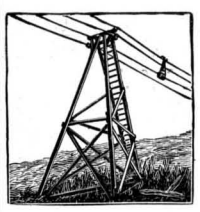

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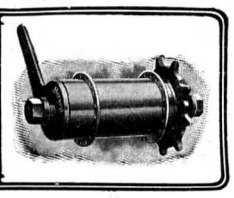

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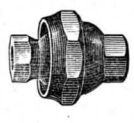

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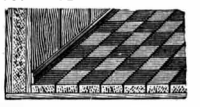

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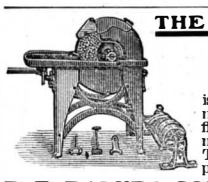

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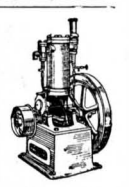

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